

# ASH GROVE CEMENT COMPANY



"WESTERN REGION"

February 22, 1995

Fred Austin  
Air Pollution Engineer  
Puget Sound Air Pollution Control Agency  
110 Union Street, Suite 500  
Seattle, WA 98101-2038

**Re: Draft Approval Order for injecting whole tires**

Dear Fred:

Thank you for the fax of January 11 on the subject draft approval order. Ash Grove appreciates the prompt response to the Notice of Construction and offers the following comments to the draft:

The proposed injection of whole tires falls under the solid waste definitions of resource recovery (recycling of tires for energy use), not incineration. Therefore, the WAC 173-434-XXX referred to in the draft is deemed by Ash Grove not to be applicable.

The following comments refer to the numbering in the draft:

Condition 4 The tires pyrolyze in the kiln and some of the gases from the pyrolysis probably burn in the calciner. In other permitting work, Ash Grove has standardized on the term "non-hazardous waste fuel substitute". There is a typo in the last line: "W" has been dropped from WAC. With this in mind, it is proposed that the language in this condition be modified as follows:

Ash Grove shall limit waste fuel substitutes for the kiln system ~~Kiln replacement fuels~~ to fuels that are non-hazardous as defined by WAC 173-303-515, Special Requirements for Used Oil Burned for Energy Recovery, or by WAC 173-303-090, Dangerous Waste Characteristics, as appropriate.

Condition 5 Legal counsel has advised Ash Grove that the Federal New Source Performance Standards (NSPS) for Municipal Solid Waste Combustors (MSWs) might apply to the burning of tires in the kiln. These regulations contain standards not currently applicable to the plant, such as emission limits for dioxin and furans and hydrochloric acid.

Tires are a municipal solid waste under the definitions of these federal regulations. However, the Seattle kiln can claim exemption from the regulations as a "cofired combustor". "Cofired combustor" is a defined term meaning combustion units that are limited pursuant to a federally enforceable permit condition to burning 30 percent or less, by weight, of MSW (40 CFR § 60.51a). Ash Grove wants to avoid questions about the applicability of the MSW NSPS by measuring the fuel substitution rate by weight rather than by latent heat. There is a relatively small difference in the latent heat value of the different fuels (whole tires: ~24 GJ/Mg, coal: ~22 GJ/Mg, natural gas: ~26 GJ/Mg) so the same percentage can be used. The condition should be changed as follows:

Ash Grove shall limit the amount of non-hazardous waste fuel substitute replacement fuel, on a daily average, to no more than 30 % ~~of the heat input by weight of the fuel consumption requirement of the kiln system to manufacture cement.~~

Condition 6a The tires will be weighed on a scale in the tire feeding system. Coal is currently weighed and the natural gas flow is measured. By applying a natural gas density that can be obtained from the supplier, the natural gas weight can be calculated. All measuring devices are calibrated in accordance with the manufacturer's instructions. The hourly and daily average values are printed daily by the plant's process computer. The records will be kept for five years and will be available for PSAPCA inspection. Accordingly, the first part of this condition (text following 6 and (a), (i) and (ii)) can be deleted and the following added to condition 5:

a. Ash Grove may demonstrate compliance with this condition by:

- (i) Maintaining measuring devices that allow the continuous determination of the weight of all fuels entering the kiln system.
- (ii) Calibrating the devices in (i) in accordance with manufacturers instructions.
- (iii) Recording the daily average weights of all fuels consumed by the kiln system.
- (iv) Calculating the daily average percentage of all fuels consumed that are non-hazardous waste fuel substitutes.
- (v) Maintaining records of data in (iii) and (iv) for no less than five years.

Condition 6b, Condition 7 Today about 20 cement plants in the United States are



burning whole tires or tire derived fuel. The mere fact that so many plants are permitted is testimony to this being an accepted practice with insignificant effect on ambient air quality. Most, if not all, of the permitted plants have done extensive source testing to characterize emissions with tires and many have also done a baseline source test without tires. Since Ash Grove's Portland office has permitted three plants for tire burning in recent years, it has available to it source tests from these three plants as well as from other plants. These tests are listed in the table below.

Type of test	Company	Att.	Location of kiln	Date of test	Pollutants tested for
Baseline with fossil only, then with tires	Ash Grove Cement	1	Durkee, OR	October 1989	TSP, SO <sub>2</sub> , Cl, THC, POHC, metals
	Holnam	2	Seattle, WA	October 1990	TSP, SO <sub>2</sub> , NO <sub>x</sub> , CO, metals, Many organics
	Lafarge	3	?	?	TSP, SO <sub>2</sub> , NO <sub>x</sub> , metals, Cr(VI)
	Rinker Materials	4	Miami, FL	January 1993	SO <sub>2</sub> , NO <sub>x</sub> , CO, THC
Tires only	Ash Grove Cement	5	Durkee, OR	August 1991	TSP, Metals
	Ash Grove Cement	6	Durkee, OR	August 1994	TSP, NO <sub>x</sub> , CO, metals, THC
	Calaveras Cement	7	Redding, CA	1989	Metals, Cr(VI)
Fossil only	Ash Grove Cement	8	Seattle, WA	Sept. 1994	THC, TO-14, HCl, TCDD

Excerpts of the eight tests are attached. Please note that the Durkee and Redding kiln systems are very similar to Seattle's. The results of the tests can be summarized as follows:

Particulates (attachments 1, 2, 3, 5, 6, 7) Particulate emissions were lower when substituting portions of the fossil fuel with tire fuel and in all cases were within permitted limits.

SO<sub>2</sub>, NO<sub>x</sub>, CO (attachments 1, 2, 3, 4, 6) In all cases, the SO<sub>2</sub> and NO<sub>x</sub> went down when burning tires. In most cases, the CO went down; but in a few, it went up a bit. In all instances, gaseous emissions of criteria pollutants were well within permitted limits.

If the CO goes up a bit in the Seattle plant from the current average around 600 ppm<sub>dv</sub> @ 10 % O<sub>2</sub>, there is still ample "headroom" to the permit limit of 1000 ppm<sub>dv</sub> @ 10 % O<sub>2</sub>.

Metals (attachments 1, 2, 3, 5, 6, 7) In most cases, metals emissions went down, but in some, lead and mercury emissions went up. The metals concentration in the captured dust is about the same whether burning tires or not and the variation in emissions is closely tied to the particulate emission rate. The Seattle plant's modern baghouse and stringent PM<sub>10</sub> emission limit will ensure that metals emissions remain well below the standards in Regulation I and III.

Organic hazardous air pollutants (attachments 1, 2, 4, 6, 8) Overall, emission of hydrocarbons remained the same or went down when burning tires. The organic compounds identified did not change significantly.

State of California<sup>1</sup> and USEPA<sup>2</sup> documents reach similar conclusions. The study of two California dry process kilns similar to Seattle's is summed up as follows:

"The results of air pollutant emissions testing at RMC Lonestar and Southwestern Portland indicate that burning 18 to 25 percent tires (on a total heat input basis) as a supplement to coal in a precalcining type kiln does not result in any appreciable difference in toxic air emissions. The results of criteria pollutant testing were also similar for both firing scenarios."

The source testing suggested in draft condition 6a is likely to cost \$15,000 to \$20,000. On the strength of the data summarized above, Ash Grove believes this expenditure to be frivolous. It should be unnecessary to prepare a baseline and tire burning source test. The considerable tire burning source test data base show no exceptions to the experience that emissions generally improve when burning tires and increases for pollutants, such as CO, if they occur, are modest. The existing limits for criteria pollutants will serve as safeguards that combustion is properly controlled and that the industry experience is repeated at Ash Grove's Seattle plant. Accordingly, Ash Grove

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<sup>1</sup>"Tires as a Fuel Supplement: Feasibility Study", Report to the Legislature, California Integrated Waste Management Board, January, 1992. Quote from page 40.

<sup>2</sup>"Burning Tires for Fuel and Tire Pyrolysis: Air Implications", EPA-450/3-91-024

suggests that condition 6b and condition 7 be removed from the draft permit.

Condition 8 The source test data from the eight tests tabulated above have been compared with the acceptable source impact levels for compounds listed in PSAPCA's Regulation III, Appendix A. Those compounds identified in the source tests which are also on the Appendix A list were tabulated in the attached spreadsheet labeled "ASH GROVE CEMENT COMPANY, SEATTLE PLANT; POTENTIAL SOURCE IMPACT LEVELS FROM TIRE BURNING". The highest values from all eight tests were chosen to develop a worst case stack emission rate. This rate was diluted using modeling data from the 1990 PSD application for the plant to obtain the potential ambient impact. This potential was compared with the acceptable source impact levels in Regulation III. It was found that the impact for each and all of the compounds in the spreadsheet was lower than the acceptable levels.

As a result of the analysis above Ash Grove proposes that draft condition 8 be deleted.

-oOo-

I hope you agree to the suggested changes. Looking forward to hearing from you.

Sincerely,



Gerald J. Brown  
Safety and Environmental Manager

cc:  
Hans E. Steuch  
Eric Hansen/McCulley Frick & Gilman

...\\seattle\\02-18-95.1



**ASH GROVE CEMENT COMPANY, SEATTLE PLANT  
POTENTIAL SOURCE IMPACT LEVELS FROM TIREBURNING**

Compound name	CAS Code	Plant emission factors in kg/Mg clinker, (1), (2), (3)						Highest emission factor kg/Mg CK	Highest Seattle emissions g/sec (5)	SIL $\mu\text{g}/\text{m}^3$ (6)	ASIL avg. period	ASIL (4) $\mu\text{g}/\text{m}^3$	fraction of ASIL	OK?
		1	2	5	6	7	8							
Acetone	67-64-1		9.9E-04					9.9E-04	2.3E-02	2.2E-02	24-hour	5900	0%	Yes
Antimony & compounds, as Sb	7440-36-0				1.0E-06			1.0E-06	2.3E-05	2.3E-05	24-hour	1.7	0%	Yes
Arsenic & inorg. Ar compounds	7440-38-2			7.2E-06	6.1E-07	4.9E-06		7.2E-06	1.7E-04	3.5E-05	Annual	0.00023	15%	Yes
Barium, soluble compounds Ba	7440-39-3			1.5E-04				1.5E-04	3.5E-03	3.4E-03	24-hour	1.7	0%	Yes
Benzene	71-43-2		4.3E-03				4.6E-03	4.6E-03	1.1E-01	2.2E-02	Annual	0.12	18%	Yes
Benzo(a)pyrene	50-32-8				2.1E-06			2.1E-06	4.9E-05	1.0E-05	Annual	0.0006	2%	Yes
Benzo(k)fluoranthene	205-08-9		2.6E-05					2.6E-05	6.0E-04	1.2E-04		none		
Beryllium and its compounds	7440-41-7			7.3E-07	1.7E-07	7.3E-07		7.3E-07	1.7E-05	3.5E-06	Annual	0.00042	1%	Yes
Bis(2-ethylhexyl)phtalate	117-81-7		9.6E-04					9.6E-04	2.2E-02	4.6E-03	Annual	16.7	0%	Yes
1,3 Butadiene	106-99-0		5.7E-05					5.7E-05	1.3E-03	2.7E-04	Annual	73.3	0%	Yes
2-Butanone	78-93-3		1.4E-05					1.4E-05	3.2E-04	3.2E-04	24-hour	1000	0%	Yes
Cadmium and compounds	7440-43-9		5.4E-06	2.1E-05	1.1E-07	9.3E-06		2.1E-05	4.9E-04	1.0E-04	Annual	0.00056	18%	Yes
Carbon disulfide	75-15-0		2.2E-03					2.2E-03	5.1E-02	5.0E-02	24-hour	100	0%	Yes
Chlorobenzene	108-90-7		1.7E-05					1.7E-05	3.9E-04	3.8E-04	24-hour	150	0%	Yes
Chloroethane	75-00-3		3.9E-05					3.9E-05	9.0E-04	8.8E-04	24-hour	10000	0%	Yes
Chloromethane	74-87-3		5.3E-04					5.3E-04	1.2E-02	1.2E-02	24-hour	340	0%	Yes
Chromium (III) compounds	7440-47-3		2.0E-05	2.1E-04	4.2E-06	2.1E-05		2.1E-04	4.9E-03	4.8E-03	24-hour	1.7	0%	Yes
Chromium (VI) compounds	7440-47-3					4.1E-07		4.1E-07	9.5E-06	9.3E-06	24-hour	0.00008	11%	Yes
Copper, fume	7440-50-8		8.9E-05		2.8E-05	8.7E-06		8.9E-05	2.1E-03	2.0E-03	24-hour	0.67	0%	Yes
Dibenzofurans	132-64-9	1.1E-05						1.1E-05	2.5E-04	5.3E-05		none		
Dichloromethane	75-09-2		5.0E-04					5.0E-04	1.2E-02	2.4E-03	Annual	0.6	0%	Yes
Dimethyl phtalate	131-11-3		2.0E-05					2.0E-05	4.6E-04	4.5E-04	24-hour	17	0%	Yes
Ethylbenzene	100-41-4		1.1E-04				1.9E-04	1.9E-04	4.4E-03	4.3E-03	24-hour	1000	0%	Yes
Hydrogen chloride	7647-01-0						5.5E-04	5.5E-04	1.3E-02	1.2E-02	24-hour	7	0%	Yes
Lead compounds	7439-92-1		1.2E-04		3.2E-06	2.6E-05		1.2E-04	2.8E-03	2.7E-03	24-hour	0.5	1%	Yes
Manganese, dust and compounds	7439-96-5				1.4E-05	6.7E-05		6.7E-05	1.5E-03	1.5E-03	24-hour	0.4	0%	Yes
Mercury as Hg, Alkyl compounds	7439-97-6					7.4E-05		7.4E-05	1.7E-03	1.7E-03	24-hour	0.33	1%	Yes

**ASH GROVE CEMENT COMPANY, SEATTLE PLANT  
POTENTIAL SOURCE IMPACT LEVELS FROM TIREBURNING**

Compound name	CAS Code	Plant emission factors in kg/Mg clinker, (1), (2), (3)						Highest emission factor kg/Mg CK	Highest Seattle emissions g/sec (5)	SIL $\mu\text{g}/\text{m}^3$ (6)	ASIL avg. period	ASIL (4) $\mu\text{g}/\text{m}^3$	fraction of ASIL	OK?
		1	2	5	6	7	8							
Methyl bromide	74-83-9						7.0E-04	7.0E-04	1.6E-02	1.6E-02	24-hour	5	0%	Yes
Methyl chloride	74-87-3						3.2E-03	3.2E-03	7.4E-02	7.2E-02	24-hour	340	0%	Yes
Naphtalene	91-20-3	5.5E-05	1.1E-03					1.1E-03	2.5E-02	2.5E-02	24-hour	170	0%	Yes
Nickel & compounds (7)	7440-02-2			2.3E-04	5.1E-06	1.1E-04		2.3E-04	5.3E-03	1.1E-03	Annual	0.0021	53%	Yes
Nitrobenzene	98-95-3		1.6E-05					1.6E-05	3.7E-04	3.6E-04	24-hour	1.7	0%	Yes
Phenol	108-95-2		1.3E-03					1.3E-03	3.0E-02	2.9E-02	24-hour	63.3	0%	Yes
Polyaromatic Hydrocarbons (8)	43116*	4.6E-05						4.6E-05	1.1E-03	2.2E-04	Annual	0.00048	46%	Yes
Selenium compounds, as Se	7782-49-2		1.4E-05		6.1E-07	2.9E-05		2.9E-05	6.7E-04	6.6E-04	24-hour	0.67	0%	Yes
Silver, soluble compounds as Ag	7440-22-4				2.8E-07			2.8E-07	6.5E-06	6.3E-06	24-hour	0.033	0%	Yes
Styrene	100-42-5						2.2E-04	2.2E-04	5.1E-03	5.0E-03	24-hour	1000	0%	Yes
Thallium soluble compounds, Tl	7440-28-0				5.4E-06			5.4E-06	1.2E-04	1.2E-04	24-hour	0.33	0%	Yes
Toluene	108-88-3		7.5E-04				1.7E-03	1.7E-03	3.9E-02	3.8E-02	24-hour	400	0%	Yes
Trichlorofluoromethane	75-69-4		1.8E-05					1.8E-05	4.2E-04	4.1E-04	24-hour	19000	0%	Yes
Vanadium, as V2O5	1314-62-1			5.8E-06				5.8E-06	1.3E-04	1.3E-04	24-hour	0.17	0%	Yes
Vinyl chloride	75-01-4		3.5E-05				2.0E-04	2.0E-04	4.6E-03	9.6E-04	Annual	0.012	8%	Yes
Xylenes (m-, o-, p-isomers)	1330-20-7		3.0E-03				2.5E-04	3.0E-03	6.9E-02	6.8E-02	24-hour	1500	0%	Yes
Zinc oxide, fume	1314-13-2		1.8E-02	2.1E-03	1.2E-05	5.2E-03		1.8E-02	4.2E-01	4.1E-01	24-hour	17	2%	Yes

(1) 1 = Ash Grove Cement, Durkee, OR, 10/89; 2 = Holnam, Seattle, WA, 10/90; 3 = Lafarge, location & date & tonnage unknown; 4 = Rinker Materials, Miami, FL, 1/93, no compounds on ASIL list; 5, 6 = Ash Grove Cement, Durkee, OR, 8/91 and 8/94; 7 = Calaveras Cement, Redding, CA, 1989; 8 = Ash Grove Cement, Seattle, WA, 9/94.

(2) To make this a conservative estimate the highest number from each run, or test if runs were not available, was entered into the table.

(3) If a compound concentration was below the limit of detection (LOD) half of the LOD value was entered into the table.

(4) The most restrictive metal ASIL was chosen from Regulation III even if the metals emitted are not necessarily in the form identified by the most restrictive metal ASIL.

(5) At the rated production rate of 2200 short tons per day of clinker = 2.31E-02 Megagram per second.

(6) Ambient concentrations based on point of maximum impact determined by dispersion modeling for 1990 PSD permit for 24-hour and annual averaging periods.

(7) As Nickel subsulfide or nickel refinery dust.

(8) PAHs quantified according to WAC 173-460-050 (4)d.

# Att. 1



Department of Environmental Quality  
Air Quality Control Division

AIR CONTAMINANT DISCHARGE PERMIT APPLICATION REVIEW REPORT

Ash Grove Cement West, Inc.  
330 Cement Plant Rd.  
Durkee, OR 97905

Background

Ash Grove Cement West, Inc. operates a cement plant near Durkee, Oregon. On September 5, 1989 Ash Grove Cement West Inc. filed an application with the Department to modify their Air Contaminant Discharge Permit to allow substitution of tire derived fuel (TDF) for up to 10% (btu basis) of their kiln firing fuel needs. TDF would be added to coal, used oil and natural gas as fuel options. Pilot feasibility testing with up to 10% TDF fuel was conducted in 1988. Tests during that time showed no increase in emissions of particulate or sulfur dioxide. TDF consists of shredded pieces of tires approximately two inches or less in size. Steel belting and bead wire is removed. Prior to acting on this request, the Department required the applicant to obtain the services of a private testing contractor to gather emission data from the cement kiln exhaust stack. This testing was required to determine emissions under current operating conditions and also what changes, if any, would occur when a small percentage of TDF was added to the fuel stream.

Testing was done on October 18-20, 1989 for total particulate, selected metals, sulfur dioxide (SO<sub>2</sub>), chloride (Cl<sup>-</sup>), and polynuclear aromatic hydrocarbons (PAH). Department personnel were present during portions of the testing to verify testing protocol.

Four series of background tests were conducted utilizing the fuels normally used in kiln firing, (i.e coal, natural gas and oil).

Four additional tests were conducted where TDF replaced normally used fuels with approximately 9-10% tire chips.

Collected emission samples were then analyzed by other independent laboratories and the Department's analytical laboratory.

Following is a recap of testing results:

Baseline testing  
without tire fuel

Total Particulate 5.27 lbs/hr

Average of all runs without  
tire fuel

Sulfur dioxide (SO<sub>2</sub>) <1.5 lbs/hr

Chloride (Cl<sup>-</sup>) .268 lbs/hr

Testing with 9-10%  
tire fuel added

Total Particulate 4.83 lbs/hr

Average of all tire runs  
with tires

Sulfur dioxide (SO<sub>2</sub>) < 1.2 lbs/hr

Chloride (Cl<sup>-</sup>) .197 lbs/hr

Total Hydrocarbons 3.0 lbs/hr      Total Hydrocarbons 3.3 lbs/hr  
Polynuclear Aromatic Hydrocarbons      Polynuclear Aromatic Hydrocarbons

Naphthalene  
Dibenzofuran  
Phenanthrene

Naphthalene  
Dibenzofuran  
Phenanthrene

Average of all runs 0.0058 lbs/hr      Average of tire runs 0.0053 lbs/hr

Vaporous Heavy Metals  
highest concentration detected  
without tires

Vaporous Heavy Metals  
highest concentration detected  
with tires

Total micrograms

Arsenic	0.2
Cadmium	3.0
Chromium	30
Nickel	30
Zinc	35
Copper	37
Lead	Not Detected
Iron	400
Barium	Not Detected
Vanadium	Not Detected

Total Micrograms

Arsenic	0.2
Cadmium	2.0
Chromium	Not Detected
Nickel	Not Detected
Zinc	35
Copper	13
Lead	Not Detected
Iron	200
Barium	Not Detected
Vanadium	Not Detected

Following is a discussion of testing results for each pollutant class.

Particulate

Results from the eight test runs averaged 5.07 lbs/hr. When TDF was added to the kiln firing, the particulate emissions dropped slightly to 4.83 lbs/hr. The established permit limits for Ash Grove's cement kiln are 18.0 lbs/hr.

Sulfur Dioxide (SO<sub>2</sub>)

SO<sub>2</sub> testing showed an average emission rate for all tests at less than 1.5 lbs/hrs. Testing results when TDF was added showed an emission rate of less than 1.2 lbs/hr. Ash Grove's permit limit is 6.3 lbs/hr.

Chloride Emissions

Chloride (Cl<sup>-</sup>) testing showed an average emission rate for all tests of .268 lbs/hr. Results with tire derived fuel added were .197 lbs/hr.



### Dioxin

In recent years, environmental scientists have been increasingly concerned about emissions of a chlorinated compound known as dibenzo-p-dioxin (CDD). Of specific concern is polychlorinated dibenzo-p-dioxin containing four or more chlorine atoms (PCDD).

Recent studies by the U.S. Environmental Protection Agency have shown that dioxin emissions are most likely when dioxin is present in the material burned.

Dioxin formation is also likely when dioxin precursors are present in the material being burned. Precursors are complex chlorinated organic compounds, such as chlorinated phenols or chlorinated benzene. TDF does not contain dioxin or precursors.

Dioxin formation has also been found to occur when chlorine is present in the fuel under conducive fuel and combustion conditions.

The Department has reviewed the chloride emissions from the Ash Grove tests, kiln operating parameters and normal fuel characteristics. Emissions of chloride during Ash Grove testing were less with tire derived fuel than under normal kiln firing without TDF. Consequently, the Department finds that the use of TDF as a supplemental fuel does not enhance the potential for dioxin formation.

### Total Hydrocarbons

Emission testing for total hydrocarbons showed results similar when burning TDF and under conditions when TDF was not burned. There are no permit limitations on these pollutants and they are not addressed further.

### Polynuclear Aromatic Hydrocarbons (PAH)

Polynuclear Aromatic Hydrocarbons (PAH's) are a normal byproduct of combustion of fossil fuel, wood, and most other fuels. Some PAH's are known or suspected of being carcinogens. Collected samples were analyzed by the Department's analytical laboratory utilizing a Gas Chromatograph Mass Spectrophotometer to determine which compounds were present and their concentrations. Samples were screened for seventeen specific PAH's which is standard procedure for analytical testing. Only three PAH's were detected and each was detected in all eight samples, (i.e. with and without tire chips being burned.)

The highest concentration for the combination of these three compounds occurred when tire chips were not being burned and are shown below:

Naphthalene	0.0069 lbs/hr
Dibenzofuran	0.0014 lbs/hr
Phenanthrene	0.0003 lbs/hr

The eight test samples were further scanned for approximately 115 other compounds. No other compounds of significance were detected.



None of the compounds detected are listed as human carcinogens or possibly human carcinogens.

#### Vaporous Heavy Metals

Analysis for metals was conducted for each of the eight samples. For the ten metals tested, emissions during the tire chip burning were equal to or less than emission testing when tire chips were not being burned,

There is no evidence that the emission concentrations shown for any of these metals warrant concern.

#### Conclusions from Source Testing Analysis

A screening model was then done on the detected emissions. The results projected a concentration rate of 250 times less at ground level compared to these concentrations being emitted from the stack at approximately 280' above ground level.

The Department has reviewed the test data and has concluded that the use of TDF will not cause an increase in overall facility emissions or toxicity of emissions and will not cause or contribute to any ambient air quality problems. Current Plant Site Emission Limits are adequate for the use of 10% TDF.

#### Ambient Monitoring

In an unrelated matter, the Department is requiring the company to implement a one year ambient monitoring program to assess the impact of Ash Grove Cement West's particulate emissions on air quality in the vicinity of the Durkee Cement Plant. This monitoring would be conducted to provide a demonstration of the effectiveness of plant site control of fugitive, upset conditions, and normal operation for particulate emissions.

A sampling network of Hi-vol samplers will be located as prescribed by the Department. Wind direction and speed sensors will be maintained to provide hourly averages.

All data collected during the 12 month sampling period will be reported to the Department quarterly. The monitoring program will be subject to quality assurance auditing by the Department.

#### Public Notice

The permit modification request was placed on Public Notice in April 1990. A public hearing was held on May 15, 1990 and the comment period closed on May 22, 1990. Issues raised during this period are addressed in a separate hearing report.

RCH:a  
P010029R (6/90)



505 N.E. Thompson Mill Road

Corbett, Oregon 97019

503/695-2151

## EMISSIONS TEST REPORT

ASH GROVE CEMENT WEST'S KILN EXHAUST STACK  
AT DURKEE, OREGON

TIRE DERIVED FUEL TRIALS

October 18-20, 1989

Prepared for

Ash Grove Cement West, Inc.  
330 Cement Plant Road  
P.O. Box 5  
Durkee, Oregon 97905

by

David R. Rossman, P.E.



Mechanical Engineering ☐ Energy Audits ☐ Air Pollution Emission Testing  
Infrared Inspection ☐ Machine Design

AGCS2M002555

SEA0958

CERTIFICATION

I certify that the sampling, analytical procedures, and data presented in this report are authentic and accurate. To the best of my knowledge, all the testing details and conclusions are accurate and valid. Samples were collected, transported and delivered to the laboratories by me or my staff. Analytical work was done by several independent laboratories and the DEQ.

David R. Rossman

David R. Rossman, P.E.

Date: 12/19/89



### Introduction

Source tests for particulate, selected metals, sulfur dioxide ( $\text{SO}_2$ ), chloride ( $\text{Cl}^-$ ), and principle organic hazardous compounds (POHC) were conducted from October 18 to 20, 1989 on Ash Grove Cement West's cement kiln exhaust at Durkee, Oregon.

These tests were done to fulfill the requirements for annual particulate testing and obtain information on what effect the use of scrap rubber tire chips (TDF) as a supplemental fuel would have on emissions. These tests were done to satisfy the requirements of the Air Contaminant Discharge Permit issued by the Oregon Department of Environmental Quality (DEQ) and to answer the questions of community residents on the impact of the plant on the local airshed.

Richard Duval, from DEQ's Eastern Region, was present during some of the testing. Spence Erickson, the DEQ technical person who specified the details of the testing, did not visit. Doug Hale is the Environmental Manager at Ash Grove and arranged for the testing. Kirsten Badger and Jim Peterson of Ash Grove assisted Kirk Meekin of Horizon Engineering, and the test engineer, David Rossman, in operation of the emissions testing equipment.

### Summary of Results

Particulate emissions from the eight test runs averaged 0.0065 gr/scfd and 5.07 lb/hr, with the highest run at 0.011 gr/scfd and 9.0 lb/hr, so the particulate limit for this plant of 0.1 gr/scfd and 18 lb/hr was being met during all of the test runs. The highest result was during an unusual time when the raw mill was off line.

Particulate emissions during the TDF runs were not appreciably different than when it was not being fired, nor was there much difference when coal fuel was fired instead of natural gas.

Other parameters measured,  $\text{SO}_2$ ,  $\text{Cl}^-$ , POHC, and THC, also showed little or no increase when the TDF was added. Both the  $\text{SO}_2$  and  $\text{Cl}^-$  results were generally very near the detectable limit of the methods used. As with the particulate, the highest or nearly highest results were found during the baseline tests firing natural gas in the kiln. One POHC component of particular interest, chrysene, was not detectable in any of the samples.

The results of analysis for metals in the particulate catch is included in the Appendix. Of the ten metals checked, iron was the highest, with zinc and copper being the only others of significance on all the runs except the last two (baseline tests) where there was some nickel and chromium.

Table 1 on the next page shows the averaged results of tests, grouped by the fuels fired. The results of the individual tests are listed later in the report as Tables 2, 3, and 4.

No formal opacity readings were taken, but at no time did informal observations show more than 5-10 % opacity. Usually the exhaust was clear.

A photograph of the plant is shown in Figure 1. The stack exit is behind the top of the steel structure.

The results of the tests should be valid in all respects. All leak tests and isokinetic values were within the acceptable range. Filter appearance was a very light brown. Probe wash acetone was only slightly cloudy; it did not appear to have much suspended material in it.

Table 1  
TDF Trials Emission Test Results Summary  
October 18-29, 1989

Parameter	Average Runs 1-2	Run 3	Average Runs 4-6	Average <sup>*</sup> Runs 7-8
Fuels, % of Btu in (See below for key)	C= 88 WO= 12	C= 89 WO= 7 TDF= 4	NG= 82 WO= 10 TDF= 9	NG= 87 WO= 13
Particulate				
- gr/scfd	0.0057	0.0063	0.0062	0.0078
- lb/hr	4.28	4.98	4.83	6.27
Allowable				
- gr/scfd	0.1	0.1	0.1	0.1
- lb/hr	18.2	18.2	18.2	18.2
SO <sub>2</sub>				
- ppmv	<1.3	<1.3	<1.3	<1.8
- lb/hr	<1.2	<1.2	<1.2	<1.7
Allowable				
- ppmv	10	10	10	10
- lb/hr	6.3	6.3	6.3	6.3
Cl <sup>-</sup>				
- lb/hr	<0.11	<0.18	<0.20	0.34
POHC				
- lb/hr	0.006	0.003	0.005	0.008
THC				
- ppmC	18	16	20	18
- lbC/hr	3.0	2.6	3.3	3.1
Sample Volume, scfd	54.6	57.5	58.6	57.3
Part. Sample Wt, mg	20.3	23.4	23.8	29.7
Sampling Time, min	120	120	120	120
% Isokinetic	103	102	107	101
System Flowrate, scfm	87,600	92,900	90,600	93,000
Stack Temp, °F	254	250	257	263
% Moisture,	17.1	16.1	20.7	19.6
% O <sub>2</sub> ,	9.1	9.1	8.8	9.4
Cement Type,	II	II	II	II
Feed Rate, tons <sup>**</sup> /hr	96	101	104	94

\* Run 7 had Raw Mill off

\*\* Metric tons

C=Coal

WO=Waste Oil

NG= Nat Gas

TDF= Tire Chips

\*\*\*\*\* HORIZON ENGINEERING \*\*\*\*\*

AGCS2M002559

SEA0962



Lab #1 89-1113  
Sample: BLANK  
Item #1 9

```
=====
CONC      COMPOUND      CAS #
ug
=====
```

<0.2	Naphthalene	91203
<0.3	Acenaphthylene	208968
<0.3	Acenaphthene	83329
<0.2	Dibenzofuran	132649
<0.3	Fluorene	86737
<0.3	Phenanthrene	85018
<0.3	Anthracene	120127
<0.2	Fluoranthene	206440
<0.2	Pyrene	129000
<0.2	Benzo[a]anthracene	56553
<0.3	Chrysene	218019
<0.5	Benzo[b]fluoranthene	205992
<0.7	Benzo[k]fluoranthene	207089
<0.5	Benzo[a]pyrene	50328
<6.0	Indeno[1,2,3-cd]anthracene	193395
<1.0	Dibenz[ah]anthracene	53703
<1.0	Benzo[ghi]perylene	191242

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Polynuclear Aromatic Hydrocarbons  
Acid-Base/Neutral Extractables  
Complies with NPDES method 625  
and RCRA SW846 method 8270

Date: 29 November 89

Lab #: 89-1113

Sample: Run 7

Item #: 7

CONC	COMPOUND	CAS #
ug		
20	Naphthalene	91203
<0.3	Acenaphthylene	208968
<0.3	Acenaphthene	83329
4	Dibenzofuran	132649
<0.3	Fluorene	86737
1	Phenanthrene	85018
<0.3	Anthracene	120127
<0.2	Fluoranthene	206440
<0.2	Pyrene	129000
<0.2	Benzo[a]anthracene	56553
<0.3	Chrysene	218019
<0.5	Benzo[b]fluoranthene	205992
<0.7	Benzo[k]fluoranthene	207089
<0.5	Benzo[a]pyrene	50328
<6.0	Indeno[1,2,3-cd]anthracene	193395
<1.0	Dibenz[ah]anthracene	53703
<1.0	Benzo[ghi]perylene	191242

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Polynuclear Aromatic Hydrocarbons  
Acid-Base/Neutral Extractables  
Complies with NPDES method 625  
and RCRA SW846 method 8270

Date: 05 December 89

Lab #: 89-1113

Sample: RUN 6

Item #: 6

CONC	COMPOUND	CAS #	
ug			
	7	Naphthalene	91203
<0.3		Acenaphthylene	208968
<0.3		Acenaphthene	83329
	3	Dibenzofuran	132649
<0.3		Fluorene	86737
	2	Phenanthrene	85018
<0.3		Anthracene	120127
<0.2		Fluoranthene	206440
<0.2		Pyrene	129000
<0.2		Benzo[a]anthracene	56553
<0.3		Chrysene	218019
<0.5		Benzo[b]fluoranthene	205992
<0.7		Benzo[k]fluoranthene	207089
<0.5		Benzo[a]pyrene	50328
<6.0		Indeno[1,2,3-cd]anthracene	193395
<1.0		Dibenz[ah]anthracene	53703
<1.0		Benzo[ghi]perylene	191242



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Polynuclear Aromatic Hydrocarbons  
Acid-Base/Neutral Extractables  
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and RCRA SW846 method 8270

Date: 05 December 89

Lab #: 89-1113

Sample: RUN 5

Item #: 5

CONC	COMPOUND	CAS #
ug		
14	Naphthalene	91203
<0.3	Acenaphthylene	208968
<0.3	Acenaphthene	83329
3	Dibenzofuran	132649
<0.3	Fluorene	86737
2	Phenanthrene	85018
<0.3	Anthracene	120127
<0.2	Fluoranthene	206440
<0.2	Pyrene	129000
<0.2	Benzo[a]anthracene	56553
<0.3	Chrysene	218019
<0.5	Benzo[b]fluoranthene	205992
<0.7	Benzo[k]fluoranthene	207089
<0.5	Benzo[a]pyrene	50328
<6.0	Indeno[1,2,3-cd]anthracene	193395
<1.0	Dibenz[ah]anthracene	53703
<1.0	Benzo[ghi]perylene	191242

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Polynuclear Aromatic Hydrocarbons  
Acid-Base/Neutral Extractables  
Complies with NPDES method 625  
and RCRA SW846 method 8270

Date: 30 November 89

Lab #: 89-1113

Sample: RUN 4

Item #: 4

CONC	COMPOUND	CAS #
ug		
10	Naphthalene	91203
<0.3	Acenaphthylene	208968
<0.3	Acenaphthene	83329
3	Dibenzofuran	132649
<0.3	Fluorene	86737
3	Phenanthrene	85018
<0.3	Anthracene	120127
<0.2	Fluoranthene	206440
<0.2	Pyrene	129000
<0.2	Benzo[a]anthracene	56553
<0.3	Chrysene	218019
<0.5	Benzo[b]fluoranthene	205992
<0.7	Benzo[k]fluoranthene	207089
<0.5	Benzo[a]pyrene	50328
<6.0	Indeno[1,2,3-cd]anthracene	193395
<1.0	Dibenz[ah]anthracene	53703
<1.0	Benzo[ghi]perylene	191242

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Polynuclear Aromatic Hydrocarbons  
Acid-Base/Neutral Extractables  
Complies with NPDES method 625  
and RCRA SW846 method 8270

Date: 01 December 89

Lab #: 89-1113

Sample: RUN 3

Item #: 3

CONC	COMPOUND	CAS #
ug		
5	Naphthalene	91203
<0.3	Acenaphthylene	208968
<0.3	Acenaphthene	83329
2	Dibenzofuran	132649
<0.3	Fluorene	86737
2	Phenanthrene	85018
<0.3	Anthracene	120127
<0.2	Fluoranthene	206440
<0.2	Pyrene	129000
<0.2	Benzo[a]anthracene	56553
<0.3	Chrysene	218019
<0.5	Benzo[b]fluoranthene	205992
<0.7	Benzo[k]fluoranthene	207089
<0.5	Benzo[a]pyrene	50328
<6.0	Indeno[1,2,3-cd]anthracene	193395
<1.0	Dibenz[ah]anthracene	53703
<1.0	Benzo[ghi]perylene	191242



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Acid-Base/Neutral Extractables  
Complies with NPDES method 625  
and RCRA SW846 method 8270

Date: 01 December 89

Lab #: 89-1113

Sample: RUN 2

Item #: 2

CONC	COMPOUND	CAS #
ug		
17	Naphthalene	91203
<0.3	Acenaphthylene	208968
<0.3	Acenaphthene	83329
3	Dibenzofuran	132649
<0.3	Fluorene	86737
2	Phenanthrene	85018
<0.3	Anthracene	120127
<0.2	Fluoranthene	206440
<0.2	Pyrene	129000
<0.2	Benzo[a]anthracene	56553
<0.3	Chrysene	218019
<0.5	Benzo[b]fluoranthene	205992
<0.7	Benzo[k]fluoranthene	207089
<0.5	Benzo[a]pyrene	50328
<6.0	Indeno[1,2,3-cd]anthracene	193395
<1.0	Dibenz[ah]anthracene	53703
<1.0	Benzo[ghi]perylene	191242

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Polynuclear Aromatic Hydrocarbons  
Acid-Base/Neutral Extractables  
Complies with NPDES method 625  
and RCRA SW846 method 8270

Date: 01 December 89

Lab #1 89-1113

Sample: RUN 1

Item #1 1

CONC	COMPOUND	CAS #
ug		
6	Naphthalene	91203
<0.3	Acenaphthylene	208968
<0.3	Acenaphthene	83329
3	Dibenzofuran	132649
<0.3	Fluorene	86737
3	Phenanthrene	85018
<0.3	Anthracene	120127
<0.2	Fluoranthene	206440
<0.2	Pyrene	129000
<0.2	Benzo[a]anthracene	56553
<0.3	Chrysene	218019
<0.5	Benzo[b]fluoranthene	205992
<0.7	Benzo[k]fluoranthene	207089
<0.5	Benzo[a]pyrene	50328
<6.0	Indeno[1,2,3-cd]anthracene	193395
<1.0	Dibenz[ah]anthracene	53703
<1.0	Benzo[ghi]perylene	191242

HORIZON ENGINEERING  
505 N.E. Thompson Mill Road  
Corbett, Oregon 97019

Principle Organic Hazardous Compounds (POHC)  
Emission Calculations

Plant: Ash Grove Cement West  
Source: ESP Stack  
Location: Durkee, Oregon  
Test Dates: October 18-20, 1989

Method of Sampling: Modified Method 5  
Resin Used: XAD-2

Run No.: 8

Sample Volume, Qd, scfd: 54.252  
Stack Flowrate, qs, scfm: 91,346

$$\text{Eqn: lbX/hr} = \text{ugX} \frac{(\text{qs, ft}^3/\text{min})(60 \text{ min/hr})}{(\text{Qd, ft}^3)(1,000,000 \text{ ug/g})(453)}$$

No.	Compound Name	Lab Rslt. Emiss. Rate	
		ug	lb/hr
1	Naphthalene	23.3	0.0052
2	Dibenzofuran	5.0	0.0011
3	Phenanthrene	1.7	0.0004
4			0.0000
5			0.0000
6			0.0000
7			0.0000
8			0.0000
9			0.0000
10			0.0000
11			0.0000
12			0.0000
13			0.0000
Total		30.0	0.0067



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Corbett, Oregon 97019

Principle Organic Hazardous Compounds (POHC)  
Emission Calculations

Plant: Ash Grove Cement West  
Source: ESP Stack  
Location: Durkee, Oregon  
Test Dates: October 18-20, 1989

Method of Sampling: Modified Method 5  
Resin Used: XAD-2

Run No.: 7

Sample Volume, Qd, scfd: 60.251  
Stack Flowrate, qs, scfm: 94,733

$$\text{Eqn: lbX/hr} = \text{ugX} \frac{(\text{qs, ft}^3/\text{min})(60 \text{ min/hr})}{(\text{Qd, ft}^3)(1,000,000 \text{ ug/g})(453)}$$

No.	Compound Name	Lab Rslt.	Emiss. Rate
		ug	lb/hr
1	Naphthalene	33.3	0.0069
2	Dibenzofuran	6.7	0.0014 (1)
3	Phenanthrene	1.7	0.0003
4			0.0000
5			0.0000
6			0.0000
7			0.0000
8			0.0000
9			0.0000
10			0.0000
11			0.0000
12			0.0000
13			0.0000
Total		41.7	0.0087

$$(1) \frac{0.0014 \times .454 \text{ ug/hr}}{56.7 \text{ ug ck/hr}} = 1.1 \times 10^{-4} \text{ ug/Mg CK}$$

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Principle Organic Hazardous Compounds (POHC)  
Emission Calculations

Plant: Ash Grove Cement West  
Source: ESP Stack  
Location: Durkee, Oregon  
Test Dates: October 18-20, 1989

Method of Sampling: Modified Method 5  
Resin Used: XAD-2

Run No.: 6

Sample Volume, Qd, scfd: 59.932  
Stack Flowrate, qs, scfm: 91.138

$$\text{Eqn: lbX/hr} = \text{ugX} \frac{(\text{qs, ft}^3/\text{min})(60 \text{ min/hr})}{(\text{Qd, ft}^3)(1,000,000 \text{ ug/g})(453)}$$

No.	Compound Name	Lab Rslt.	Emiss. Rate
		ug	lb/hr
1	Naphthalene	11.7	0.0023
2	Dibenzofuran	5.0	0.0010
3	Phenanthrene	3.3	0.0007
4			0.0000
5			0.0000
6			0.0000
7			0.0000
8			0.0000
9			0.0000
10			0.0000
11			0.0000
12			0.0000
13			0.0000
Total		20.0	0.0040

HORIZON ENGINEERING  
505 N.E. Thompson Mill Road  
Corbett, Oregon 97019

Principle Organic Hazardous Compounds (POHC)  
Emission Calculations

Plant: Ash Grove Cement West  
Source: ESP Stack  
Location: Durkee, Oregon  
Test Dates: October 18-20, 1989

Method of Sampling: Modified Method 5  
Resin Used: XAD-2

Run No.: 5

Sample Volume, Qd, scfd: 58.943  
Stack Flowrate, qs, scfm: 92,317

$$\text{Eqn: lbX/hr} = \text{ugX} \frac{(\text{qs, ft}^3/\text{min})(60 \text{ min/hr})}{(\text{Qd, ft}^3)(1,000,000 \text{ ug/g})(453)}$$

No.	Compound Name	Lab Rslt. Emiss. Rate	
		ug	lb/hr
1	Naphthalene	23.3	0.0048
2	Dibenzofuran	5.0	0.0010
3	Phenanthrene	3.3	0.0007
4			0.0000
5			0.0000
6			0.0000
7			0.0000
8			0.0000
9			0.0000
10			0.0000
11			0.0000
12			0.0000
13			0.0000
Total		31.6	0.0066

HORIZON ENGINEERING  
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Corbett, Oregon 97019

Principle Organic Hazardous Compounds (POHC)  
Emission Calculations

Plant: Ash Grove Cement West  
Source: ESP Stack  
Location: Durkee, Oregon  
Test Dates: October 18-20, 1989

Method of Sampling: Modified Method 5  
Resin Used: XAD-2

Run No.: 4

Sample Volume, Qd, scfd: 57.033  
Stack Flowrate, qs, scfm: 88,243

$$\text{Eqn: lbX/hr} = \text{ugX} \frac{(\text{qs, ft}^3/\text{min})(60 \text{ min/hr})}{(\text{Qd, ft}^3)(1,000,000 \text{ ug/g})(453)}$$

No.	Compound Name	Lab Rslt.	Emiss. Rate
		ug	lb/hr
1	Naphthalene	16.7	0.0034
2	Dibenzofuran	5.0	0.0010
3	Phenanthrene	5.0	0.0010
4			0.0000
5			0.0000
6			0.0000
7			0.0000
8			0.0000
9			0.0000
10			0.0000
11			0.0000
12			0.0000
13			0.0000
Total		26.7	0.0055



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Principle Organic Hazardous Compounds (POHC)  
Emission Calculations

Plant: Ash Grove Cement West  
Source: ESP Stack  
Location: Durkee, Oregon  
Test Dates: October 18-20, 1989

Method of Sampling: Modified Method 5  
Resin Used: XAD-2

Run No.: 3

Sample Volume, Qd, scfd: 57.528  
Stack Flowrate, qs, scfm: 92,858

$$\text{Eqn: lbX/hr} = \text{ugX} \frac{(\text{qs, ft}^3/\text{min})(60 \text{ min/hr})}{(\text{Qd, ft}^3)(1,000,000 \text{ ug/g})(453)}$$

No.	Compound Name	Lab Rslt.	Emiss. Rate
		ug	lb/hr
1	Naphthalene	8.3	0.0018
2	Dibenzofuran	3.3	0.0007
3	Phenanthrene	3.3	0.0007
4			0.0000
5			0.0000
6			0.0000
7			0.0000
8			0.0000
9			0.0000
10			0.0000
11			0.0000
12			0.0000
13			0.0000
Total		15.0	0.0032

HORIZON ENGINEERING  
505 N.E. Thompson Mill Road  
Corbett, Oregon 97019

Principle Organic Hazardous Compounds (POHC)  
Emission Calculations

Plant: Ash Grove Cement West  
Source: ESP Stack  
Location: Durkee, Oregon  
Test Dates: October 18-20, 1989

Method of Sampling: Modified Method 5  
Resin Used: XAD-2

Run No.: 2

Sample Volume, Qd, scfd: 54.804  
Stack Flowrate, qs, scfm: 90,063

$$\text{Eqn: lbX/hr} = \text{ugX} \frac{(\text{qs, ft}^3/\text{min})(60 \text{ min/hr})}{(\text{Qd, ft}^3)(1,000,000 \text{ ug/g})(453)}$$

No.	Compound Name	Lab Rslt. Emiss. Rate	
		ug	lb/hr
1	Naphthalene	28.3	0.0062
2	Dibenzofuran	5.0	0.0011
3	Phenanthrene	3.3	0.0007
4			0.0000
5			0.0000
6			0.0000
7			0.0000
8			0.0000
9			0.0000
10			0.0000
11			0.0000
12			0.0000
13			0.0000
Total		36.6	0.0080

HORIZON ENGINEERING  
505 N.E. Thompson Mill Road  
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Principle Organic Hazardous Compounds (POHC)  
Emission Calculations

Plant: Ash Grove Cement West  
Source: ESP Stack  
Location: Durkee, Oregon  
Test Dates: October 18-20, 1989

Method of Sampling: Modified Method 5  
Resin Used: XAD-2

Run No.: 1

Sample Volume, Qd, scfd: 54.374  
Stack Flowrate, qs, scfm: 85,093

$$\text{Eqn: lbX/hr} = \text{ugX} \frac{(\text{qs, ft}^3/\text{min})(60 \text{ min/hr})}{(\text{Qd, ft}^3)(1,000,000 \text{ ug/g})(453)}$$

No.	Compound Name	Lab Rslt.	Emiss. Rate
		ug	lb/hr
1	Naphthalene	10.0	0.0021
2	Dibenzofuran	5.0	0.0010
3	Phenanthrene	5.0	0.0010
4			0.0000
5			0.0000
6			0.0000
7			0.0000
8			0.0000
9			0.0000
10			0.0000
11			0.0000
12			0.0000
13			0.0000
Total		20.0	0.0041

# Att. 2



# HOLNAM SEATTLE PLANT TDF STACK TEST SUMMARY

Parameter	Condition 1 Baseline	Condition 2 11% TDF	Condition 3 14% TDF
Total Organics (lbs/hr)	1.107	0.5263	0.3832
Organic HAPs (lbs/hr)	0.8287	0.1517	0.2575
NON-HAP Organics (lbs/hr)	0.2783	0.3746	0.1257
Total HAPs (lbs/hr)	0.8413	0.1622	0.2659
Total Particulate (lbs/hr)	48.20	22.20	24.70
Total Metals Emissions (lbs/hr)	1.378	0.7535	0.2358
HAPs Metals (lbs/hr)	0.0126	0.0105	0.0084
NON-HAPs Metals (lbs/hr)	1.365	0.7430	0.2274
PNA Emissions (lbs/hr)	0.3011	0.1861	0.2397
VOC Emissions (lbs/hr)	0.8058	0.3402	0.1434
Tons per year of total organics	4.849	2.305	1.678
Tons per year of organic HAPs	3.630	0.664	1.128
Tons per year of total particulate	211.1	97.24	108.2
Tons per year of total metals	6.034	3.300	1.033
Tons per year of HAP metals	0.0552	0.0460	0.0368
Total No. of Compounds	47	38	38
Total No. of HAPs	20	19	19
<u>SO<sub>2</sub></u>	<u>563</u>	<u>480</u>	<u>334</u>
<u>NO<sub>x</sub></u>	<u>529</u>	<u>483</u>	<u>416</u>
<u>CO</u>	<u>51</u>	<u>67</u>	<u>67</u>

# HOLNAM'S SEATTLE PLANT

## 10/90 TDF STACK TEST

Condition # 1: Baseline

Compound	Units	Run 1	Run 2	Run 3	Average (all 3 runs)	Pounds/Hr
PM Total	lbs/hr	13.3	28.7	102.7	48.2	48.2
Sulfur Dioxide (SO2)	lbs/hr	319.3	578.6	782.2	563.4	563.4
Nitrogen Oxides (NOx)	lbs/hr (as NO2)	625.1	375.5	586.9	529.2	529.2
Carbon Monoxide (CO)	lbs/hr	45.6	53.4	53.8	50.9	50.9
Carbon Dioxide (CO2)	%	22.2	22.4	22.6	22.4	93154.7
Oxygen (O2)	%	7.0	6.7	6.6	6.8	28140.5
Arsenic	mg/hr	BDL	BDL	BDL	0.0	0.0000
Cadmium	mg/hr	245.5 (1)	165.7	101.7	171.0	0.0004
Chromium	mg/hr	615.2	425.8	905.5	648.8	0.0014
Copper	mg/hr	4015.6	3923.6	2017.2	3318.8	0.0073
Lead	mg/hr	5135.9	5543.9	4056.1	4912.0	0.0108
Zinc	mg/hr	536220	813241	498082	615848	1.3577
Acenaphthene	mg/min	BDL	BDL	12.9	4.3	0.0006
Acenaphthalene	mg/min	BDL	BDL	10.3	3.4	0.0005
Anthracene	mg/min	BDL	BDL	BDL	0.0	0.0000
Benzo(a)anthracene	mg/min	BDL	11.5	BDL	3.8	0.0005
Benzo(b)fluoranthene	mg/min	8.6	18.6	18.9	15.4	0.0020
Benzo(c)fluoranthene	mg/min	BDL	BDL	BDL	0.0	0.0000
Benzo(k)fluoranthene	mg/min	9.5	19.5	19.8 (2)	16.3	0.0022
Benzo(a)pyrene	mg/min	BDL	BDL	9.5	3.2	0.0004
Benzo(g,h,i)perylene	mg/min	BDL	BDL	BDL	0.0	0.0000
Benzyl Alcohol	mg/min	BDL	BDL	BDL	0.0	0.0000
Bis(2-chloroethoxy)methane	mg/min	BDL	BDL	BDL	0.0	0.0000
Bis(2-chloroethyl)ether	mg/min	BDL	BDL	BDL	0.0	0.0000
Bis(2-chloroisopropyl)ether	mg/min	BDL	BDL	BDL	0.0	0.0000
Bis(2-ethylhexyl)phthalate	mg/min	129.1	185.7	723.0	345.9	0.0458
Butylbenzyl Phthalate	mg/min	BDL	BDL	BDL	0.0	0.0000
4-Bromophenyl-phenyl ether	mg/min	BDL	BDL	BDL	0.0	0.0000
4-chloroaniline	mg/min	BDL	BDL	BDL	0.0	0.0000
2-Chloronaphthalene	mg/min	BDL	BDL	BDL	0.0	0.0000
4-Chlorophenyl-phenyl ether	mg/min	BDL	BDL	BDL	0.0	0.0000
Chrysene	mg/min	BDL	12.4	15.5	9.3	0.0012
Dibenz(a,h)anthracene	mg/min	BDL	BDL	BDL	0.0	0.0000
Dibenzofuran	mg/min	72.3	141.5	284.0	165.9	0.0219
Di-N-butylphthalate	mg/min	BDL	10.6	BDL	3.5	0.0005
1,2-Dichlorobenzene	mg/min				0.0	0.0000
1,3-Dichlorobenzene	mg/min				0.0	0.0000
1,4-Dichlorobenzene	mg/min				0.0	0.0000
3,3-Dichlorobenzidine	mg/min				0.0	0.0000
Diethyl Phthalate	mg/min				0.0	0.0000
Dimethyl Phthalate	mg/min		15.0		5.0	0.0007
2,4-Dinitrotoluene	mg/min				0.0	0.0000
2,6-Dinitrotoluene	mg/min				0.0	0.0000
Di-N-octyl Phthalate	mg/min				0.0	0.0000
Fluoranthene	mg/min	12.9	17.7	31.8	20.8	0.0028
Fluorene	mg/min		15.0	20.7	11.9	0.0016
Hexachlorobenzene	mg/min				0.0	0.0000
Hexachlorobutadiene	mg/min				0.0	0.0000
Hexachlorocyclopentadiene	mg/min				0.0	0.0000
Hexachloroethane	mg/min				0.0	0.0000

$$(1) \frac{245.5 \times 10^{-6} \text{ kg/hr}}{50 \times 0.9072 \text{ Mg dwt/hr}} = 5.4 \times 10^{-6} \text{ kg/Mg CK}$$

$$(2) \frac{19.8 \times 10^{-6} \text{ kg/hr}}{50 \times 0.9072 \text{ Mg dwt/hr}} = 2.6 \times 10^{-5} \text{ kg/Mg CK}$$

# HOLNAM'S SEATTLE PLANT

## 10/90 TDF STACK TEST

Condition # 1: Baseline

Compound	Units	Run 1	Run 2	Run 3	Average (all 3 runs)	Pounds/Hr
Indeno(1,2,3-cd)pyrene	mg/min				0.0	0.0000
Isophorone	mg/min				0.0	0.0000
2-methyl Naphthalene	mg/min	57.6	78.7	206.6	114.3	0.0151
Naphthalene	mg/min	301.1	424.5	860.8	528.8	0.0699
2-Nitroaniline	mg/min				0.0	0.0000
3-Nitroaniline	mg/min				0.0	0.0000
4-Nitroaniline	mg/min				0.0	0.0000
Nitrobenzene	mg/min		9.7	12.1	7.3	0.0010
N-Nitrosodiphenylamine	mg/min				0.0	0.0000
N-Nitroso-Di-N-propylamine	mg/min				0.0	0.0000
Phenanthrene	mg/min	76.6	106.1	241.0	141.2	0.0187
Pyrene	mg/min			23.2	7.7	0.0010
1,2,4-Trichlorobenzene	mg/min				0.0	0.0000
4-Chloro-3-methyl Phenol	mg/min				0.0	0.0000
2-Chlorophenol	mg/min				0.0	0.0000
2,4-Dichlorophenol	mg/min				0.0	0.0000
2,4-Dimethyl Phenol	mg/min				0.0	0.0000
2,4-Dinitrophenol	mg/min		81.4		27.1	0.0036
4,6-Dinitro-2-methyl Phenol	mg/min				0.0	0.0000
2-methyl Phenol	mg/min			25.8	8.6	0.0011
4-methyl Phenol	mg/min	27.5		63.7	30.4	0.0040
2-Nitrophenol	mg/min	103.2	548.4	258.2	303.3	0.0401
4-Nitrophenol	mg/min				0.0	0.0000
Pentachlorophenol	mg/min				0.0	0.0000
Phenol	mg/min	464.6		1032.9	499.2	0.0660
2,4,5-Trichlorophenol	mg/min				0.0	0.0000
2,4,6-Trichlorophenol	mg/min				0.0	0.0000
Acetone	mg/min	668.9	606.7	752.2	675.9	0.0894
Benzene	mg/min	2113.8	1542.0	3223.7	2293.2	0.3033
Bromodichloromethane	mg/min				0.0	0.0000
Bromomethane	mg/min	26.8	48.0	29.6	34.8	0.0046
Bromoform	mg/min				0.0	0.0000
1,3-Butadiene	mg/min	6.7	25.3	43.0	25.0	0.0033
2-Butanone (MEK)	mg/min		10.9	3.5	4.8	0.0006
Carbon Disulfide	mg/min	508.4	556.1	1692.4	919.0	0.1216
Carbon Tetrachloride	mg/min				0.0	0.0000
Chlorobenzene	mg/min		12.6	10.2	7.6	0.0010
Chloroethane	mg/min		16.4	29.6	15.3	0.0020
2-Chloroethyl-vinyl-ether	mg/min				0.0	0.0000
Chloroform	mg/min				0.0	0.0000
Chloromethane	mg/min	321.1	326.6	403.0	350.9	0.0464
Dibromochloromethane	mg/min				0.0	0.0000
1,2-Dibromoethane	mg/min				0.0	0.0000
1,2-Dichlorobenzene	mg/min				0.0	0.0000
1,3-Dichlorobenzene	mg/min				0.0	0.0000
1,4-Dichlorobenzene	mg/min				0.0	0.0000
1,1-Dichloroethane	mg/min				0.0	0.0000
1,2-Dichloroethane	mg/min				0.0	0.0000
1,1-Dichloroethene	mg/min				0.0	0.0000
cis-1,2-Dichloroethene	mg/min				0.0	0.0000

# HOLNAM'S SEATTLE PLANT

10/90 TDF STACK TEST

Condition # 1: Baseline

Compound	Units	Run 1	Run 2	Run 3	Average (all 3 runs)	Pounds/Hr
trans-1,2-Dichloroethene	mg/min				0.0	0.0000
Dichloromethane	mg/min	246.2	328.6	376.1	317.0	0.0419
1,2-Dichloropropane	mg/min				0.0	0.0000
cis-1,3-Dichloropropene	mg/min				0.0	0.0000
trans-1,3-Dichloropropene	mg/min				0.0	0.0000
Ethylbenzene	mg/min	82.9	30.3	75.2	62.8	0.0083
2-Hexanone	mg/min				0.0	0.0000
4-Methyl-2-Pentanone	mg/min				0.0	0.0000
Styrene	mg/min	40.1	25.3	2.7	22.7	0.0030
1,1,2,2-Tetrachloroethane	mg/min				0.0	0.0000
Tetrachloroethene	mg/min			11.3	3.8	0.0005
Toluene	mg/min	454.9	242.7	564.1	420.6	0.0556
1,1,1-Trichloroethane	mg/min			1.3	0.4	0.0001
1,1,2-Trichloroethane	mg/min				0.0	0.0000
Trichloroethene	mg/min				0.0	0.0000
Trichlorofluoromethane (F-11)	mg/min			8.9	3.0	0.0004
Trichlorotrifluoroethane (F-113)	mg/min			13.7	4.6	0.0006
Vinyl Acetate	mg/min				0.0	0.0000
Vinyl Chloride	mg/min			26.3	8.8	0.0012
Xylenes, Total	mg/min	347.8	161.8	2256.6	922.1	0.1220
TOTAL ORGANICS						1.1070 (lbs/hr)



10/90

## SEATTLE STACK TEST

Condition # 2: 11% TDF

Compound	Units	Run 1	Run 2	Run 3	Average (all 3 runs)	Pounds/Hr
PM Total	lbs/hr	26.3	26.4	13.9	22.2	22.2
Sulfur Dioxide (SO2)	lbs/hr	427.5	577.1	434.7	479.8	479.8
Nitrogen Oxides (NOx)	lbs/hr (as NO2)	497.1	480.1	470.2	482.5	482.5
Carbon Monoxide (CO)	lbs/hr	61.9	77.5	61.9	67.1	67.1
Carbon Dioxide (CO2)	%	21.0	20.9	20.7	20.9	84945.1
Oxygen (O2)	%	7.0	6.9	7.0	7.0	28360.3
Arsenic	mg/hr				0.0	0.0000
Cadmium	mg/hr	133.6	290.2	73.6	165.8	0.0004
Chromium	mg/hr	1574.3	686.8	436.7	899.3	0.0020
Copper	mg/hr	1758.4	1880.4	1830.2	1823.0	0.0040
Lead	mg/hr	4303.9	4252.8	2451.7	3669.5	0.0081
Zinc	mg/hr	529556	336664	139417	335212	0.7390
Acenaphthene	mg/min		9.4		3.1	0.0004
Acenaphthalene	mg/min				0.0	0.0000
Anthracene	mg/min				0.0	0.0000
Benzo(a)anthracene	mg/min				0.0	0.0000
Benzo(b)fluoranthene	mg/min				0.0	0.0000
Benzoic acid	mg/min				0.0	0.0000
Benzo(k)fluoranthene	mg/min				0.0	0.0000
Benzo(a)pyrene	mg/min				0.0	0.0000
Benzo(g,h,i)perylene	mg/min				0.0	0.0000
Benzyl Alcohol	mg/min		14.5		4.8	0.0006
Bis(2-chloroethoxy)methane	mg/min				0.0	0.0000
Bis(2-chloroethyl)ether	mg/min				0.0	0.0000
Bis(2-chloroisopropyl)ether	mg/min				0.0	0.0000
Bis(2-ethylhexyl)phthalate	mg/min	55.1	674.5	79.7	269.8	0.0357
Butylbenzyl Phthalate	mg/min				0.0	0.0000
4-Bromophenyl-phenyl ether	mg/min				0.0	0.0000
4-chloroaniline	mg/min				0.0	0.0000
2-Chloronaphthalene	mg/min				0.0	0.0000
4-Chlorophenyl-phenyl ether	mg/min				0.0	0.0000
Chrysene	mg/min				0.0	0.0000
Dibenz(a,h)anthracene	mg/min				0.0	0.0000
Dibenzofuran	mg/min	60.4	77.7	85.7	74.6	0.0099
Di-N-butylphthalate	mg/min				0.0	0.0000
1,2-Dichlorobenzene	mg/min				0.0	0.0000
1,3-Dichlorobenzene	mg/min				0.0	0.0000
1,4-Dichlorobenzene	mg/min				0.0	0.0000
3,3-Dichlorobenzidene	mg/min				0.0	0.0000
Diethyl Phthalate	mg/min				0.0	0.0000
Dimethyl Phthalate	mg/min				0.0	0.0000
2,4-Dinitrotoluene	mg/min				0.0	0.0000
2,6-Dinitrotoluene	mg/min				0.0	0.0000
Di-N-octyl Phthalate	mg/min				0.0	0.0000
Fluoranthene	mg/min	12.3	16.2	18.0	15.5	0.0021
Fluorene	mg/min	8.8	12.0	12.0	10.9	0.0014
Hexachlorobenzene	mg/min				0.0	0.0000
Hexachlorobutadiene	mg/min				0.0	0.0000
Hexachlorocyclopentadiene	mg/min				0.0	0.0000
Hexachloroethane	mg/min				0.0	0.0000

# 1790 SEATTLE STACK TEST

Condition # 2: 11% TDF

Compound	Units	Run 1	Run 2	Run 3	Average (all 3 runs)	Pounds/Hr
Indeno(1,2,3-cd)pyrene	mg/min				0.0	0.0000
Isophorone	mg/min				0.0	0.0000
2-methyl Naphthalene	mg/min	50.8	67.5	70.3	62.9	0.0083
Naphthalene	mg/min	210.1	273.2	351.6	278.3	0.0368
2-Nitroaniline	mg/min				0.0	0.0000
3-Nitroaniline	mg/min				0.0	0.0000
4-Nitroaniline	mg/min				0.0	0.0000
Nitrobenzene	mg/min				0.0	0.0000
N-Nitrosodiphenylamine	mg/min				0.0	0.0000
N-Nitroso-Di-N-propylamine	mg/min				0.0	0.0000
Phenanthrene	mg/min	60.4	82.0	79.7	74.0	0.0098
Pyrene	mg/min		11.1		3.7	0.0005
1,2,4-Trichlorobenzene	mg/min				0.0	0.0000
4-Chloro-3-methyl Phenol	mg/min				0.0	0.0000
2-Chlorophenol	mg/min				0.0	0.0000
2,4-Dichlorophenol	mg/min				0.0	0.0000
2,4-Dimethyl Phenol	mg/min				0.0	0.0000
2,4-Dinitrophenol	mg/min			12.0	4.0	0.0005
4,6-Dinitro-2-methyl Phenol	mg/min				0.0	0.0000
2-methyl Phenol	mg/min				0.0	0.0000
4-methyl Phenol	mg/min	29.8	12.8		14.2	0.0019
2-Nitrophenol	mg/min	61.3	170.8	557.3	263.1	0.0348
4-Nitrophenol	mg/min			231.5	77.2	0.0102
Pentachlorophenol	mg/min				0.0	0.0000
Phenol	mg/min	376.4	350.1	24.9	250.5	0.0331
2,4,5-Trichlorophenol	mg/min				0.0	0.0000
2,4,6-Trichlorophenol	mg/min				0.0	0.0000
Acetone	mg/min	89.4	177.5	56.5	107.8	0.0143
Benzene	mg/min	86.7	48.4	105.4	80.2	0.0106
Bromodichloromethane	mg/min				0.0	0.0000
Bromomethane	mg/min	3.4	5.6	10.0	6.3	0.0008
Bromoform	mg/min				0.0	0.0000
1,3-Butadiene	mg/min	4.5			1.5	0.0002
2-Butanone (MEK)	mg/min	3.7			1.2	0.0002
Carbon Disulfide	mg/min	28.9	32.3	54.0	38.4	0.0051
Carbon Tetrachloride	mg/min		2.7		0.9	0.0001
Chlorobenzene	mg/min	1.3			0.4	0.0001
Chloroethane	mg/min				0.0	0.0000
2-Chloroethyl-vinyl-ether	mg/min				0.0	0.0000
Chloroform	mg/min				0.0	0.0000
Chloromethane	mg/min	31.5	51.1	92.5	58.4	0.0077
Dibromochloromethane	mg/min				0.0	0.0000
1,2-Dibromoethane	mg/min				0.0	0.0000
1,2-Dichlorobenzene	mg/min				0.0	0.0000
1,3-Dichlorobenzene	mg/min				0.0	0.0000
1,4-Dichlorobenzene	mg/min				0.0	0.0000
1,1-Dichloroethane	mg/min				0.0	0.0000
1,2-Dichloroethane	mg/min				0.0	0.0000
1,1-Dichloroethene	mg/min				0.0	0.0000
cis-1,2-Dichloroethene	mg/min				0.0	0.0000

10/90 SEATTLE STACK TEST

Condition # 2: 11% TDF

Compound	Units	Run 1	Run 2	Run 3	Average (all 3 runs)	Pounds/Hr
trans-1,2-Dichloroethene	mg/min				0.0	0.0000
Dichloromethane	mg/min	5519.4	941.4	107.9	2189.6	0.2896
1,2-Dichloropropane	mg/min				0.0	0.0000
cis-1,3-Dichloropropene	mg/min				0.0	0.0000
trans-1,3-Dichloropropene	mg/min				0.0	0.0000
Ethylbenzene	mg/min	5.5	2.7	8.2	5.5	0.0007
2-Hexanone	mg/min				0.0	0.0000
4-Methyl-2-Pentanone	mg/min				0.0	0.0000
Styrene	mg/min		2.7		0.9	0.0001
1,1,2,2-Tetrachloroethane	mg/min				0.0	0.0000
Tetrachloroethene	mg/min	4.5	5.1	2.8	4.1	0.0005
Toluene	mg/min	39.4	14.8	30.8	28.3	0.0037
1,1,1-Trichloroethane	mg/min	10.5	5.6	3.1	6.4	0.0008
1,1,2-Trichloroethane	mg/min				0.0	0.0000
Trichloroethene	mg/min				0.0	0.0000
Trichlorofluoromethane (F-11)	mg/min	5.3	8.1	4.9	6.1	0.0008
Trichlorotrifluoroethane (F-113)	mg/min	2.1	4.6	1.8	2.8	0.0004
Vinyl Acetate	mg/min				0.0	0.0000
Vinyl Chloride	mg/min				0.0	0.0000
Xylenes, Total	mg/min	57.8	13.2	28.3	33.1	0.0044
TOTAL ORGANICS						0.5263 (lbs/hr)



# 10/90 SEATTLE STACK TEST

Condition # 3: 14% TDF

Compound	Units	Run 1	Run 2	Run 3	Average (all 3 runs)	Pounds/Hr
PM Total	lbs/hr	25.2	23.6	25.2	24.7	24.7
Sulfur Dioxide (SO2)	lbs/hr	422.3	300.1	279.6	334.0	334.0
Nitrogen Oxides (NOx)	lbs/hr (as NO2)	423.3	424.7	401.0	416.3	416.3
Carbon Monoxide (CO)	lbs/hr	69.7	65.0	65.8	66.8	66.8
Carbon Dioxide (CO2)	%	22.0	21.5	21.0	21.5	86514.2
Oxygen (O2)	%	6.9	7.2	7.2	7.1	28569.8
Arsenic	mg/hr				0.0	0.0000
Cadmium	mg/hr	79.1	34.6	82.4	65.4	0.0001
Chromium	mg/hr	361.2	306.0	353.2	340.1	0.0007
Copper	mg/hr	1495.8	1283.0	1119.0	1302.6	0.0029
Lead	mg/hr	3746.5	3342.0	3262.7	3450.4	0.0076
Zinc	mg/hr	132889	95383	77097	101790	0.2244
Acenaphthene	mg/min		9.6		3.2	0.0004
Acenaphthalene	mg/min				0.0	0.0000
Anthracene	mg/min				0.0	0.0000
Benzo(a)anthracene	mg/min				0.0	0.0000
Benzo(b)fluoranthene	mg/min				0.0	0.0000
Benzolc acid	mg/min				0.0	0.0000
Benzo(k)fluoranthene	mg/min				0.0	0.0000
Benzo(a)pyrene	mg/min				0.0	0.0000
Benzo(g,h,i)perylene	mg/min				0.0	0.0000
Benzyl Alcohol	mg/min	13.0	20.0	15.2	16.1	0.0021
Bis(2-chloroethoxy)methane	mg/min				0.0	0.0000
Bis(2-chloroethyl)ether	mg/min				0.0	0.0000
Bis(2-chloroisopropyl)ether	mg/min				0.0	0.0000
Bis(2-ethylhexyl)phthalate	mg/min	40.8	1129.8	116.0	428.9	0.0567
Butylbenzyl Phthalate	mg/min				0.0	0.0000
4-Bromophenyl-phenyl ether	mg/min				0.0	0.0000
4-chloroaniline	mg/min				0.0	0.0000
2-Chloronaphthalene	mg/min				0.0	0.0000
4-Chlorophenyl-phenyl ether	mg/min				0.0	0.0000
Chrysene	mg/min				0.0	0.0000
Dibenz(a,h)anthracene	mg/min				0.0	0.0000
Dibenzofuran	mg/min	95.5	130.4	87.5	104.5	0.0138
Di-N-butylphthalate	mg/min				0.0	0.0000
1,2-Dichlorobenzene	mg/min				0.0	0.0000
1,3-Dichlorobenzene	mg/min				0.0	0.0000
1,4-Dichlorobenzene	mg/min				0.0	0.0000
3,3-Dichlorobenzidene	mg/min				0.0	0.0000
Diethyl Phthalate	mg/min				0.0	0.0000
Dimethyl Phthalate	mg/min				0.0	0.0000
2,4-Dinitrotoluene	mg/min				0.0	0.0000
2,6-Dinitrotoluene	mg/min				0.0	0.0000
Di-N-octyl Phthalate	mg/min				0.0	0.0000
Fluoranthene	mg/min	12.2	19.1	10.7	14.0	0.0019
Fluorene	mg/min	9.5	14.8	8.9	11.1	0.0015
Hexachlorobenzene	mg/min				0.0	0.0000
Hexachlorobutadiene	mg/min				0.0	0.0000
Hexachlorocyclopentadiene	mg/min				0.0	0.0000
Hexachloroethane	mg/min				0.0	0.0000



# 10/90 SEATTLE STACK TEST

Condition # 3: 14% TDF

Compound	Units	Run 1	Run 2	Run 3	Average (all 3 runs)	Pounds/Hr
Indeno(1,2,3-cd)pyrene	mg/min				0.0	0.0000
Isophorone	mg/min				0.0	0.0000
2-methyl Naphthalene	mg/min	74.6	104.3	70.5	83.1	0.0110
Naphthalene	mg/min	164.9	417.2	160.7	247.6	0.0328
2-Nitroaniline	mg/min				0.0	0.0000
3-Nitroaniline	mg/min				0.0	0.0000
4-Nitroaniline	mg/min				0.0	0.0000
Nitrobenzene	mg/min	9.5	13.9		7.8	0.0010
N-Nitrosodiphenylamine	mg/min				0.0	0.0000
N-Nitroso-Di-N-propylamine	mg/min				0.0	0.0000
Phenanthrene	mg/min	71.2	95.6	66.1	77.6	0.0103
Pyrene	mg/min		10.4		3.5	0.0005
1,2,4-Trichlorobenzene	mg/min				0.0	0.0000
4-Chloro-3-methyl Phenol	mg/min				0.0	0.0000
2-Chlorophenol	mg/min				0.0	0.0000
2,4-Dichlorophenol	mg/min				0.0	0.0000
2,4-Dimethyl Phenol	mg/min				0.0	0.0000
2,4-Dinitrophenol	mg/min				0.0	0.0000
4,6-Dinitro-2-methyl Phenol	mg/min				0.0	0.0000
2-methyl Phenol	mg/min				0.0	0.0000
4-methyl Phenol	mg/min		35.6	35.7	23.8	0.0031
2-Nitrophenol	mg/min	416.6	208.6	178.5	267.9	0.0354
4-Nitrophenol	mg/min	138.9			46.3	0.0061
Pentachlorophenol	mg/min				0.0	0.0000
Phenol	mg/min	234.3	634.4	562.4	477.0	0.0631
2,4,5-Trichlorophenol	mg/min				0.0	0.0000
2,4,6-Trichlorophenol	mg/min				0.0	0.0000
Acetone	mg/min	115.4	157.0	140.9	137.8	0.0182
Benzene	mg/min	165.2	303.8	203.5	224.2	0.0297
Bromodichloromethane	mg/min				0.0	0.0000
Bromomethane	mg/min	18.6	22.0	28.7	23.1	0.0031
Bromoform	mg/min				0.0	0.0000
1,3-Butadiene	mg/min	1.6	15.9		5.8	0.0008
2-Butanone (MEK)	mg/min	3.7	8.6	7.8	6.7	0.0009
Carbon Disulfide	mg/min	125.9	126.6	135.7	129.4	0.0171
Carbon Tetrachloride	mg/min	2.6	2.5	2.6	2.6	0.0003
Chlorobenzene	mg/min		4.1	1.8	2.0	0.0003
Chloroethane	mg/min				0.0	0.0000
2-Chloroethyl-vinyl-ether	mg/min				0.0	0.0000
Chloroform	mg/min				0.0	0.0000
Chloromethane	mg/min	136.4	167.1	133.1	145.5	0.0193
Dibromochloromethane	mg/min				0.0	0.0000
1,2-Dibromoethane	mg/min				0.0	0.0000
1,2-Dichlorobenzene	mg/min				0.0	0.0000
1,3-Dichlorobenzene	mg/min				0.0	0.0000
1,4-Dichlorobenzene	mg/min				0.0	0.0000
1,1-Dichloroethane	mg/min				0.0	0.0000
1,2-Dichloroethane	mg/min				0.0	0.0000
1,1-Dichloroethene	mg/min				0.0	0.0000
cis-1,2-Dichloroethene	mg/min				0.0	0.0000

# 10/90 SEATTLE STACK TEST

Condition # 3: 14% TDF

Compound	Units	Run 1	Run 2	Run 3	Average (all 3 runs)	Pounds/Hr
trans-1,2-Dichloroethene	mg/min				0.0	0.0000
Dichloromethane	mg/min	112.8	151.9	112.2	125.6	0.0166
1,2-Dichloropropane	mg/min				0.0	0.0000
cis-1,3-Dichloropropene	mg/min				0.0	0.0000
trans-1,3-Dichloropropene	mg/min				0.0	0.0000
Ethylbenzene	mg/min	4.7	15.2	112.2	44.0	0.0058
2-Hexanone	mg/min				0.0	0.0000
4-Methyl-2-Pentanone	mg/min				0.0	0.0000
Styrene	mg/min	2.6	6.8	5.5	5.0	0.0007
1,1,2,2-Tetrachloroethane	mg/min				0.0	0.0000
Tetrachloroethene	mg/min	2.6	5.1	6.3	4.7	0.0006
Toluene	mg/min	31.5	55.7	133.1	73.4	0.0097
1,1,1-Trichloroethane	mg/min	3.7	2.5	2.9	3.0	0.0004
1,1,2-Trichloroethane	mg/min				0.0	0.0000
Trichloroethene	mg/min				0.0	0.0000
Trichlorofluoromethane (F-11)	mg/min	4.5	5.6	6.5	5.5	0.0007
Trichlorotrifluoroethane (F-113)	mg/min	1.6	2.0	3.9	2.5	0.0003
Vinyl Acetate	mg/min				0.0	0.0000
Vinyl Chloride	mg/min				0.0	0.0000
Xylenes, Total	mg/min	19.7	45.6	365.3	143.5	0.0190
TOTAL ORGANICS						0.3832 (lbs/hr)

# Att. 3

Kiln #3 Emission Data (lbs/hr)			
	0% TDF	30% TDF	Dif
NOx	131.5	126.3	-5.2
SO2	139.3	138.5	-0.8
VOC	1.4	0.8	-0.6
Particulate M <sub>r</sub>	5.4	4.6	-0.8
Lead	0.00480	0.03900	0.03420
Mercury	0.00008	0.00014	0.00006
Arsenic	0.00011	0.00009	-0.00002
Cadmium	0.00041	0.00035	-0.00006
Chromium VI	0.00064	0.00004	-0.00060
Nickel	0.00312	0.00140	-0.00172
Zinc	0.00283	0.00130	-0.00153
*Emissions adjusted to maximum production levels			

Health Risk Index		
	0% TDF	30% TDF
Carcinogenic	6.00E-02	8.78E-03
Noncarcinogenic	1.79E-06	3.39E-07

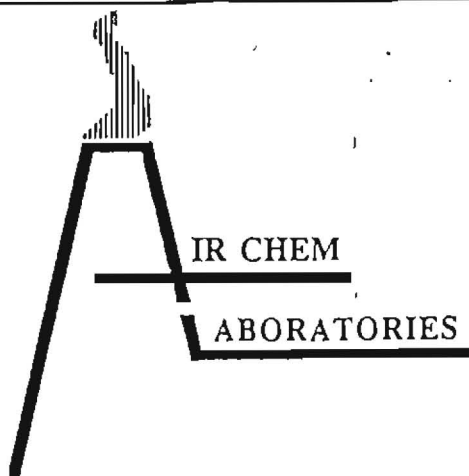
# Att. 4



**RINKER MATERIALS CORPORATION**  
**Preliminary Tire-Derived Fuel (TDF) Test Results**  
 January, 1993

CO — Method 10				
Run	Baseline		TDF	
	PPM	lbs./hr.	PPM	lbs./hr.
1	889	464	364	198
2	811	435	421	247
3	727	379	450	259
Avg		426		235
SO <sub>2</sub> — Method 6C				
Run	Baseline		TDF	
	PPM	lbs./hr.	PPM	lbs./hr.
1	243	286	148.7	186
2	279	342	137.1	183
3	280	333	287.3	378
Avg		320		249
NO <sub>x</sub> — Method 7E				
Run	Baseline		TDF	
	PPM	lbs./hr.	PPM	lbs./hr.
1	1042	883	1153	1033
2	1401	1233	949	913
3	1672	1431	880	832
Avg		1182		926
THC — Method 25A				
Run	Baseline		TDF	
	PPM	lbs./hr.	PPM	lbs./hr.
1	13.9	11.3	11.9	10.2
2	14.5	12.2	19.1	17.6
3	13.5	11.0	20.5	18.5
Avg		11.5		15.4

# Att. 5



EPA EMISSIONS COMPLIANCE TESTS FOR MODIFIED METHOD 5  
PARTICULATES AND METALS ON EMISSIONS FROM ASH GROVE  
CEMENT COMPANY'S MAIN STACK LOCATED IN DURKEE, OREGON

AIR CHEM LABORATORIES  
463 WEST 3600 SOUTH  
SALT LAKE CITY, UTAH 84115

EPA EMISSIONS COMPLIANCE TESTS FOR MODIFIED METHOD 5  
PARTICULATES AND METALS ON EMISSIONS FROM ASH GROVE  
CEMENT COMPANY'S MAIN STACK LOCATED IN DURKEE, OREGON

Field Engineers:  
Craig Rhodes  
Tim Rhodes

Test Date:  
August 13 and 14, 1991

Prepared For:

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Safety and Environmental Manager  
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Prepared By:

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## APPENDIX

- A. Calibration Data
- B. Field and Laboratory Data



EPA EMISSIONS COMPLIANCE TESTS FOR MODIFIED METHOD 5  
PARTICULATES AND METALS ON EMISSIONS FROM ASH GROVE  
CEMENT COMPANY'S MAIN STACK LOCATED IN DURKEE, OREGON

I. INTRODUCTION

At the request of Mr. Doug Hale, Ashgrove Cement's representative, Air Chem Laboratories conducted a "modified Method 5 Particulate and Metals Emissions Test" on the main stack located in Durkee, Oregon. In addition to the annual compliance test, a complete test was conducted while the facility was using an alternative tire derived fuel (TDF). The purpose of the separate tests was to determine the difference between total particulate and metals emission loading between the two different fuel types. The tests were conducted on August 13 and 14, 1991. Mr. Mark Fisher, Source Testing Coordinator for the Oregon State Air Quality Bureau, observed all sampling procedures.

II. SUMMARY

The final results from the emission tests used are summarized below.

TABLE I

DATA SUMMARY

Run No.	Date	Gas Volume Sampled	Average Velocity of Stack Gases	Particulate Collected	Particulate Emissions		
		(DSCF)	(ft/sec)	(mg)	(gr/DSCF)	(lb/hr)	(lb/DSCF)
1	8/13/91	121.427	29.97	98.7	0.0125	9.57	1.79E-6
2	8/13/91	119.201	28.75	118.0	0.0153	11.38	2.18E-6
3	8/13/91	121.202	29.11	92.4	0.0118	8.86	1.68E-6
4	8/14/91	124.181	30.20	54.0	0.0067	5.14	9.59E-7

### III. PROCEDURES AND METHODS

#### A. GENERAL PLANT OPERATIONS

The continuous facility quarries rock and produces cement. The effluent gases are processed through a multicyclone system and finally run through an electrostatic precipitator before being vented to the atmosphere. Ash Grove is currently permitted to burn TDF as a portion of the fuel used to heat the kiln. An experimental permit allowed the use of a steel-belted TDF during a portion of the testing period to determine if particulate and metal emissions would be significantly different.

#### B. EMISSIONS TESTING

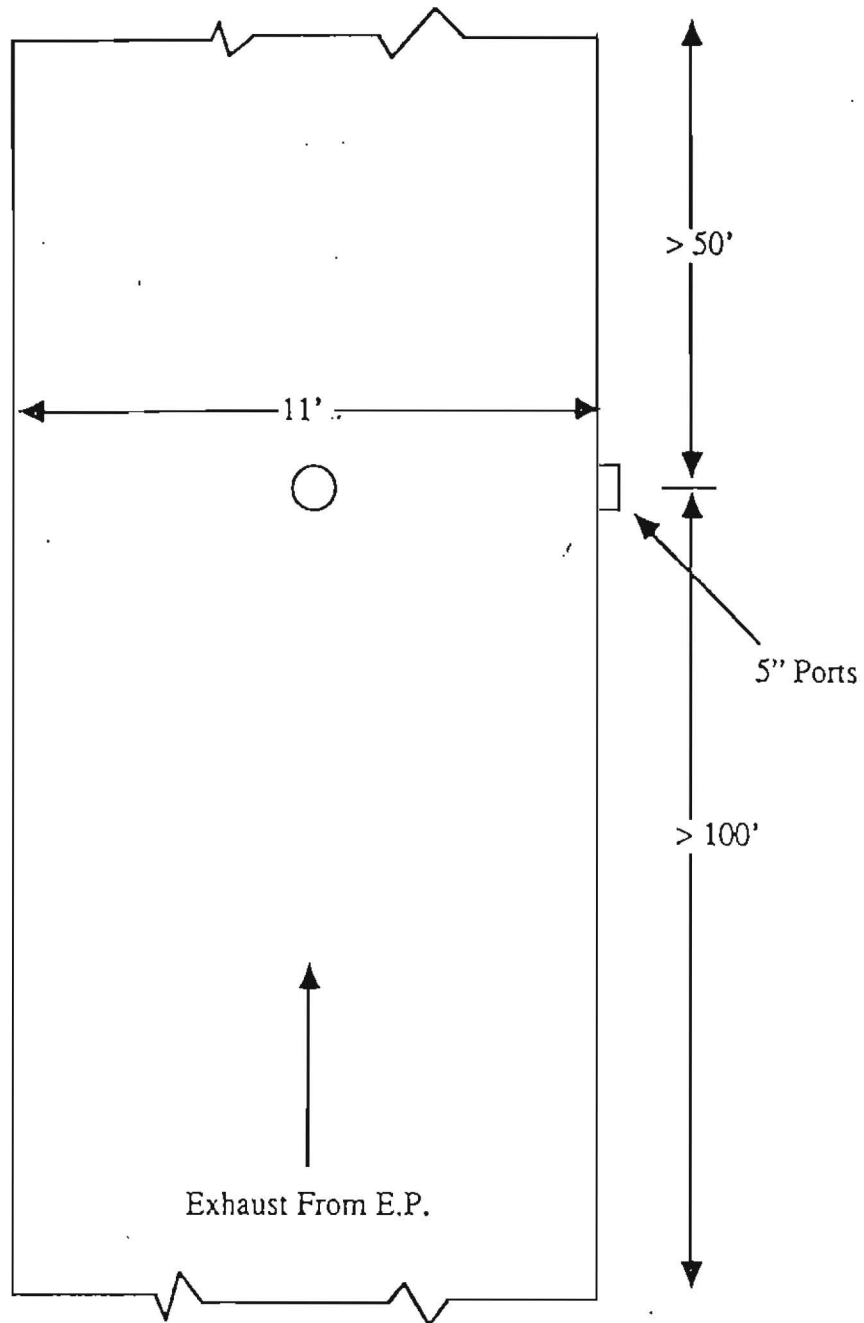
All testing procedures conducted were as specified in 40 CFR part 60 and in the Quality Assurance Handbook for Air Pollution Measurement Systems (1977).

Figure I is a diagram of the stack tested, the required distances between the ports and the upstream and downstream disturbances, one half and two diameters respectfully, were met. The configuration of the stack required the use of twenty (20) sampling points, ten (10) per port. Table II shows the distances for each of the points. Per the requirements of the Air Quality Bureau, two tests, each lasting four hours in duration, were conducted of the stack for each fuel type.

A standard EPA Method 5 sampling train (Anderson EPA sample train) was used to measure particulate emissions. The oven glassware was modified to allow the temperature of the gases exiting the probe to be measured directly. Instead of DI water, a dilute nitric acid solution was used in the first two impingers for absorption of metals emissions.

Prior to the test a cyclonic flow determination was conducted. The cyclonics of the stack were found to be an average of 2.8 degrees, falling below the maximum allowable limit of 20 degrees.

FIGURE I  
STACK DIAGRAM



Point #	point location	location from port
1 , 11	3.4	8.4
2 , 12	10.8	15.8
3 , 13	19.3	24.3
4 , 14	29.8	34.8
5 , 15	45.1	50.1
6 , 16	86.9	91.9
7 , 17	102.2	107.2
8 , 18	112.7	117.7
9 , 19	121.2	126.2
10 , 20	128.6	133.6

Stack Dimensions: 132"

Port Length: 5.0"

Data for the stack gas temperature and moisture content were collected. This data and the velocities were used to calculate the required nozzle diameter. After reviewing the relevant data, a nozzle size of 0.375" was selected for the first stack.

Three runs were completed on the August 13. The final run was completed the following day. The water in each sample train was weighed back on-site to verify moisture estimations. All particulate trains were taken to Air Chem's Salt Lake facility for sample recovery and analysis. Nozzle and probe washes were done in accordance with EPA procedures with spectronic grade acetone. In addition to the regular probe washes, a probe wash was conducted after the first probe wash on each fuel run to establish a probe wash blank.

The particulate matter from these washings was collected and weighed along with the matter collected from washing the prefilter glassware. The filters were desiccated for twenty four hours then weighed, desiccated twenty four hours and reweighed. The particulate from the probe wash, the filter, and the back half were analyzed for metal concentrations. The total metal loading for each run is reported along with the total particulate data. A full report of individual metal concentrations, blank data, and QC data can be found in the appendices.

#### IV. RESULTS AND CONCLUSIONS

##### A. METHOD 5 PARTICULATE EMISSION TEST

Four (4) test runs were conducted on the main stack. See appendix "B" for the Laboratory and Field Data Sheets. Table III summarizes the field and laboratory data. Table IV shows the calculated data.



*Where does it  
show which  
fuels?*

**TABLE III**  
**FIELD AND LABORATORY DATA**

<u>SYMBOL</u>	<u>DESCRIPTION</u>	<u>UNITS</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
V <sub>m</sub>	volume dry gas sampled @ meter conditions	ft <sup>3</sup>	136.689	140.494	141.119	143.101
P <sub>b</sub>	barometric pressure	" Hg abs.	27.3	27.3	27.3	27.3
ΔH	average pressure drop across the orifice meter	" H <sub>2</sub> O	1.03	1.00	1.02	1.06
T <sub>m</sub>	average gas meter temperature	°F	72.1	97.1	90.4	84.8
Y <sub>i</sub>	meter coefficient		0.979	0.979	0.979	0.979
V <sub>W</sub>	total H <sub>2</sub> O collected, impingers & silica gel	mls	731.0	667.0	683.0	748.0
CO <sub>2</sub>		%	13.4	13.5	13.8	13.6
O <sub>2</sub>		%	10.6	10.7	10.2	10.6
N <sub>2</sub> + CO		%	76.0	75.8	76.0	75.8
D <sub>N</sub>	nozzle diameter	"	<del>0.315</del>	<del>0.315</del>	<del>0.315</del>	<del>0.315</del> 0.37
T <sub>S</sub>	stack temperature	°F	261.4	260.5	260.5	264.7
√ΔP	velocity head of stack gas	" H <sub>2</sub> O	0.448	0.431	0.437	0.451
C <sub>p</sub>	pitot tube coefficient		0.803	0.803	0.803	0.803
P <sub>s</sub>	static pressure	" H <sub>2</sub> O	0.37	0.37	0.37	0.37
A <sub>s</sub>	area of stack	ft <sup>2</sup>	95.03	95.03	95.03	95.03
T <sub>i</sub>	net time of test	min.	240	240	240	240
Mg <sub>p</sub>	total particulates	mg	98.7	118.0	92.4	54.0

**TABLE IV**  
**DATA SUMMARY**

<u>SYMBOL</u>	<u>DESCRIPTION</u>	<u>UNITS</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
$V_{m\ std}$	volume dry gas sampled @ standard conditions*	DSCF	121.427	119.201	121.202	124.181
$B_{ws}$	proportion by volume of water vapor in gas stream	%	22.1	20.8	21.0	22.1
$M_d$	dry molecular weight	lb/lb mole	30.57	30.59	30.62	30.60
$M_s$	wet molecular weight	lb/lb mole	27.79	27.96	27.97	27.82
$V_s$	stack gas velocity	ft/sec	29.97	28.75	29.11	30.20
$Q_s$	volumetric flow rate, dry basis, standard conditions*	ft <sup>3</sup> /hr	5.34E+6	5.21E+6	5.27E+6	5.36E+6
I	isokinetic variation	%	100.0	100.7	101.2	102.0
$C_s$	concentration particulate matter in stack gas	lb/SCF	1.79E-6	2.18E-6	1.68E-6	9.59E-7
$Em_R$	emission rate	lb/hr	9.57	11.38	8.86	5.14
		gr/DSCF	0.0125	0.0153	0.0118	0.0067
$C_{s\ Met}$	concentration metal emissions in stack gas	lb/SCF	1.54E-7	1.29E-7	1.46E-7	6.31E-8
$Em_{Met}$	metals emission rate	lb/hr	0.82	0.67	0.76	0.34

\* 70°F & 29.92 " Hg

## Ashgrove Metals Cal. 8/91

Ash grove Cement							
Durkee, Or							
Steel, and non-steel belted tire destruction							
Metals calculations							
Run #1	(%)	Sample	Wt./sample	Total wt.	Cs	Em Rate	
(Metals)	(ppm)	(by wt.)	(mg/L)*	(mg)	(mg)	(lb/DSCF)	(lb/hr)
Antimony	0.0	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
Arsenic	71.0	0.01	0.28	0.01	7.01E-03	1.27E-10	6.80E-04
Barium	1400.0	0.14	5.53	0.28	1.38E-01	2.51E-09	1.34E-02
Beryllium	7.5	0.00	0.03	0.00	7.40E-04	1.34E-11	7.18E-05
Cadmium	250.0	0.03	0.99	0.05	2.47E-02	4.48E-10	2.39E-03
Chromium	2800.0	0.28	11.05	0.55	2.76E-01	5.02E-09	2.68E-02
Copper	2300.0	0.23	9.08	0.45	4.54E-01	8.24E-09	4.40E-02
Iron	73000.0	7.30	288.20	14.41	7.21E+00	1.31E-07	6.99E-01
Lead	6400.0	0.64	25.27	1.26	6.32E-01	1.15E-08	6.13E-02
Nickel	3000.0	0.30	11.84	0.59	2.96E-01	5.38E-09	2.87E-02
Thallium	0.0	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
Vanadium	32.0	0.00	0.13	0.01	3.16E-03	5.74E-11	3.06E-04
Zinc	28000.0	2.80	110.54	5.53	2.76E+00	5.02E-08	2.68E-01
Total				23.15	11.80	2.14E-7	1.14
Part. Wt.	Sample Wt.	Sample Vol	Ym	Qs			
(mg)	(mg)	(ml)	(ft3)	(lb/hr)			
98.70	98.70	50.00	121.43	5.34E+06			
Run #2	(%)	Sample	Wt./sample	Total wt.	Cs	Em Rate	
(Metals)	(ppm)	(by wt.)	(mg/L)*	(mg)	(mg)	(lb/DSCF)	(lb/hr)
Antimony	0.0	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
Arsenic	79.0	0.01	0.37	0.02	9.32E-03	1.72E-10	8.98E-04
Barium	1600.0	0.16	7.55	0.38	1.89E-01	3.49E-09	1.82E-02
Beryllium	8.0	0.00	0.04	0.00	9.44E-04	1.75E-11	9.10E-05
Cadmium	230.0	0.02	1.09	0.05	2.71E-02	5.02E-10	2.62E-03
Chromium	1400.0	0.14	6.61	0.33	1.65E-01	3.06E-09	1.59E-02
Copper	2300.0	0.23	10.86	0.54	2.71E-01	5.02E-09	2.62E-02
Iron	54000.0	5.40	254.88	12.74	6.37E+00	1.18E-07	6.14E-01
Lead	4400.0	0.44	20.77	1.04	5.19E-01	9.60E-09	5.00E-02
Nickel	2000.0	0.20	9.44	0.47	2.36E-01	4.37E-09	2.27E-02
Thallium	0.0	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
Vanadium	16.0	0.00	0.08	0.00	1.89E-03	3.49E-11	1.82E-04
Zinc	5400.0	0.34	16.05	0.80	4.01E-01	7.42E-09	3.87E-02
Total				16.39	8.19	1.52E-7	0.79
Filter Wt.	Sample Wt.	Sample Vol	Ym	Qs			
(mg)	(mg)	(ml)	(ft3)	(lb/hr)			
118.00	118.00	50.00	119.20	5.21E+06			

$$(1) \frac{8.98 \times 10^{-4} \times 0.454 \text{ kg/hr}}{56.7 \text{ kg ck/hr}} = \frac{7.2 \times 10^{-6} \text{ kg/hr}}{\text{Page 1}}$$



## Ashgrove Metals Cal. 8/91

Ash grove Cement							
Durkee, Or							
Steel, and non-steel belted tire destruction							
Metals calculations							
Run #3		(%)	Sample	Wt./sample	Total wt.	Cs	Em Rate
(Metals)	(ppm)	(by wt.)	(mg/L)*	(mg)	(mg)	(lb/DSCF)	(lb/hr)
Antimony	0.0	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
Arsenic	53.0	0.01	0.20	0.01	1.05E-02	1.90E-10	0.00
Barium	1200.0	0.12	4.44	0.22	2.37E-01	4.31E-09	0.02
Beryllium	7.7	0.00	0.03	0.00	1.52E-03	2.77E-11	0.00
Cadmium	130.0	0.01	0.48	0.02	2.57E-02	4.67E-10	0.00
Chromium	1300.0	0.13	4.80	0.24	2.57E-01	4.67E-09	0.02
Copper	1400.0	0.14	5.17	0.26	2.76E-01	5.03E-09	0.03
Iron	130000.0	13.00	480.48	24.02	2.57E+01	4.67E-07	2.43
Lead	2600.0	0.26	9.61	0.48	5.13E-01	9.34E-09	0.05
Nickel	1300.0	0.13	4.80	0.24	2.57E-01	4.67E-09	0.02
Thallium	0.0	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
Vanadium	17.0	0.00	0.06	0.00	3.36E-03	6.11E-11	0.00
Zinc	13000.0	1.30	48.05	2.40	2.57E+00	4.67E-08	0.24
Total				27.91	29.81	5.42E-7	2.83
Part. Wt.	Sample Wt.	Sample Vol	Ym	Qs			
(mg)	(mg)	(ml)	(ft3)	(lb/hr)			
92.40	92.40	50.00	121.20	5.21E+06			
Run #4		(%)	Sample	Wt./sample	Total wt.	Cs	Em Rate
(Metals)	(ppm)	(by wt.)	(mg/L)*	(mg)	(mg)	(lb/DSCF)	(lb/hr)
Antimony	0.0	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
Arsenic	26.0	0.00	0.12	0.01	3.07E-03	5.68E-11	2.96E-04
Barium	1400.0	0.14	6.61	0.33	1.65E-01	3.06E-09	1.59E-02
Beryllium	14.0	0.00	0.07	0.00	1.65E-03	3.06E-11	1.59E-04
Cadmium	78.0	0.01	0.37	0.02	9.20E-03	1.70E-10	8.87E-04
Chromium	610.0	0.06	2.88	0.14	7.20E-02	1.33E-09	6.94E-03
Copper	1200.0	0.12	5.66	0.28	1.42E-01	2.62E-09	1.36E-02
Iron	35000.0	3.50	165.20	8.26	4.13E+00	7.64E-08	3.98E-01
Lead	340.0	0.03	1.60	0.08	4.01E-02	7.42E-10	3.87E-03
Nickel	630.0	0.06	2.97	0.15	7.43E-02	1.38E-09	7.16E-03
Thallium	0.0	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
Vanadium	64.0	0.01	0.30	0.02	7.55E-03	1.40E-10	7.28E-04
Zinc	2900.0	0.29	13.69	0.68	3.42E-01	6.33E-09	3.30E-02
Total				9.97	4.99	9.22E-8	0.48
Filter Wt.	Sample Wt.	Sample Vol	Ym	Qs			
(mg)	(mg)	(ml)	(ft3)	(lb/hr)			
54.00	54.00	50.00	124.18	5.36E+06			

# Att. 6



EMISSIONS TEST  
FOR  
ASH GROVE CEMENT COMPANY'S  
CEMENT KILN EMISSION'S STACK  
LOCATED IN  
DURKEE, OREGON  
FOLLOWING  
EPA 40 CFR, PART 60, APPENDIX "A", METHOD 5  
"DETERMINATION OF PARTICULATE EMISSIONS FROM  
STATIONARY SOURCES"  
&  
EPA 40 CFR, PART 60, APPENDIX "A", METHOD 7E  
"DETERMINATION OF OXIDES OF NITROGEN EMISSIONS FROM  
STATIONARY SOURCES"  
&  
EPA 40 CFR, PART 60, APPENDIX "A", METHOD 10  
"DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM  
STATIONARY SOURCES"  
&  
EPA 40 CFR, PART 60, APPENDIX "A", METHOD 25A  
"DETERMINATION OF TOTAL ORGANIC CONCENTRATION  
USING A FLAME IONIZATION ANALYZER"  
&  
EPA 40 CFR, PART 266, APPENDIX "IX", SECTION III  
"DETERMINATION OF METALS EMISSIONS IN EXHAUST GASES  
FROM COMBUSTION PROCESSES"

TEST DATE  
AUGUST 10, 1994

## I. INTRODUCTION

At the request of Mr. Donald Guyer, Environmental and Safety Manager for Ash Grove Cement Company's, Durkee, Oregon facility, Air Chem Laboratories conducted emissions testing as required.

## II. SUMMARY OF RESULTS

The following summary lists: the Total Suspended Particulate (TSP), Oxides of Nitrogen ( $\text{NO}_x$ ), Carbon Monoxide (CO), Total Hydrocarbon (THC) and Metals emissions from testing.

## A. TSP EMISSIONS

Table I summarizes the results from testing. The table includes: date of sampling, dry gas volume collected, emission flowrate, particulate collected, emission concentration and emission rate for each test, and an average for the two runs. The field and laboratory data can be found in Appendix "B".

TABLE I  
TSP EMISSIONS  
DATA SUMMARY

Run No.	Date	Sample Volume (DSCF)	Volumetric Flowrate (DSCF/hr)	Particulate Collected (mg)	Emission Concentration		Emission Rate (lb/hr)
					(lb/DSCF)	(gr/DSCF)	
1	8/10/94	116.733	5.70E6	69.7	1.32E-6	0.0092	7.51
2	8/10/94	107.495	5.42E6	47.3	9.70E-7	0.0068	5.26
Average		112.114	5.56E6	58.5	1.15E-6	0.0080	6.39

## B. NO<sub>x</sub> EMISSIONS

Table II summarizes the results for NO<sub>x</sub> testing. The Table includes: date of sampling, emission flowrate, average concentration, emission rate for each test, and an average for the two tests. The field data can be found in Appendix "E".

TABLE II  
NO<sub>x</sub> EMISSIONS  
DATA SUMMARY

Test No.	Date	Volumetric Flowrate (DSCF/hr)	Emission Concentration			Emission Rate (lb/hr)
			(lb/DSCF)	(gr/DSCF)	(ppmv)	
1	8/10/94	5.70E6	4.03E-5	0.282	343.4	229.2
2	8/10/94	5.42E6	2.78E-5	0.195	237.1	150.7
Average		5.56E6	3.40E-5	0.238	290.3	189.1

Percent Error  
450  
475  
103

Stack = 63% of flow  
475 Stack = 44% of flow

## C. CO EMISSIONS

Table III summarizes the results for CO testing. The Table includes: date of sampling, emission flowrate, average concentration, emission rate for each test, and an average for the two tests. The field data can be found in Appendix "E".

TABLE III  
CO EMISSIONS  
DATA SUMMARY

Test No.	Date	Volumetric Flowrate (DSCF/hr)	Emission Concentration			Emission Rate (lb/hr)
			(lb/DSCF)	(gr/DSCF)	(ppmv)	
1	8/10/94	5.70E6	1.98E-5	0.138	277.2	112.6
2	8/10/94	5.42E6	2.69E-5	0.188	376.6	145.6
Average		5.56E6	2.33E-5	0.163	326.9	129.6

## D. THC EMISSIONS

Table IV summarizes the results for THC testing. The Table includes: date of sampling, emission flowrate, average concentration, emission rate for each test, and an average for the two tests. The field data can be found in Appendix "E".

TABLE IV  
THC EMISSIONS  
DATA SUMMARY

Test No.	Date	Volumetric Flowrate (DSCF/hr)	Emission Concentration			Emission Rate * (lb/hr)
			(lb/DSCF)	(gr/DSCF)	(ppmv)	
1	8/10/94	5.70E6	4.41E-7	3.08E-3	3.9	2.5
2	8/10/94	5.42E6	3.12E-7	2.19E-3	2.8	1.7
Average		5.56E6	3.76E-7	2.64E-3	3.4	2.1

\* Based on the molecular weight of propane (44 g / g - mole).

## E. METALS EMISSIONS

Table V summarizes the results for metals testing. The Table includes: average weight, average concentration, and average emission rate for the two tests. The analytical results can be found in Appendix "F".

TABLE V  
AVERAGE METALS EMISSIONS  
DATA SUMMARY

Metal	Total ( $\mu\text{g}$ )	Emission Concentration*		Emission Rate† (lb/hr)
		(lb/DSCF)	(gr/DSCF)	
Antimony	0.9	2.24E-11	1.57E-7	1.25E-4
Arsenic	0.6	1.37E-11	9.60E-8	7.64E-5
Beryllium	<0.3	<7.48E-12	<5.24E-8	<4.17E-5
Cadmium	<0.2	<4.99E-12	<3.49E-8	<2.78E-5
Chromium	3.8	9.35E-11	6.55E-7	5.21E-4
Copper	25.4	6.32E-10	4.42E-6	3.52E-3
Lead	2.9	7.23E-11	5.06E-7	4.03E-4
Manganese	12.3	3.05E-10	2.14E-6	1.70E-3
Nickel	4.6	1.13E-10	7.94E-7	6.32E-4
Selenium	0.6	1.37E-11	9.60E-8	7.64E-5
Silver	<0.5	<1.25E-11	8.73E-8	<6.94E-5
Thallium	4.9	1.21E-10	8.47E-7	6.74E-4
Zinc	10.8	2.68E-10	1.88E-6	1.49E-3

Results with a less than (<) sign indicate the detection limit and is considered the maximum possible value.

\* Average sample volume = 88.431 DSCF

† Average flowrate = 5.57E6 DSCF/hr

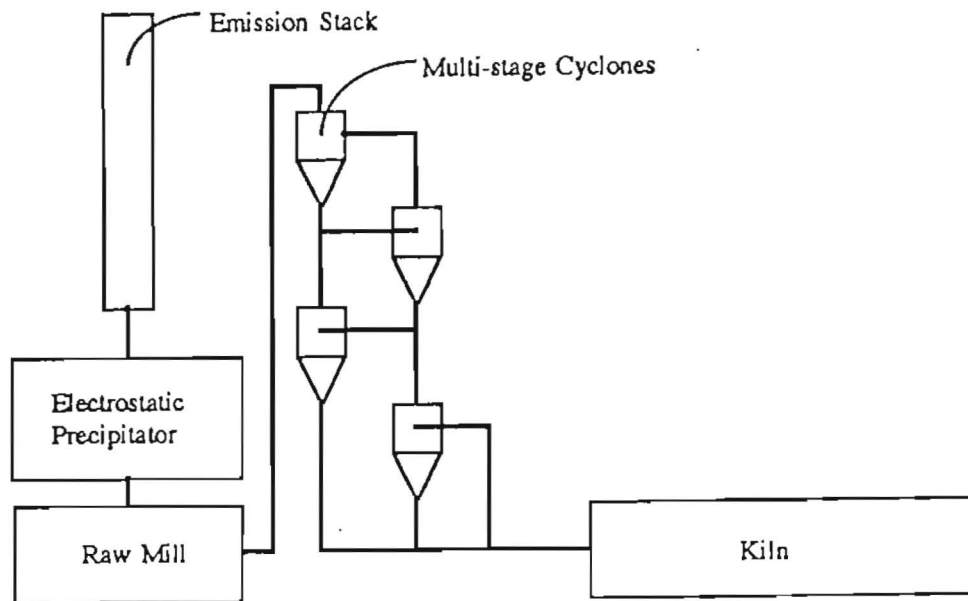
$$(1) \frac{1.25 \times 10^{-4} \text{ lb/hr}}{56.7 \text{ Mg clinker/hr}} = 1.0 \times 10^{-6} \text{ lb/Mg CK}$$

### III. PLANT OPERATIONS

#### A. PROCESS DESCRIPTION

The facility produces cement products on a continuous basis. The effluent gases are processed through a multi-cyclone system and an electrostatic precipitator before it is vented to the atmosphere. Figure I is a diagram of Ash Grove Cement Company's cement processing facility.

Figure I is a diagram of the process.



PROCESS DIAGRAM

FIGURE I



# Att. 7

**CALAVERAS**

Calaveras Cement Company  
 15390 Wonderland Boulevard  
 Redding, CA 96003  
 Telephone 916-275-1581  
 Fax 916-275-2525

August 15, 1994

Mr. Bill Siemering,  
 Vice President - Production  
 Ashgrove Cement West  
 6720 S.W. MacAdam Ave., Ste. 300  
 Portland, OR 97219

Dear Bill:

My apologies for taking so long to get back to you. The past several weeks have been rather hectic around here.

Tabulated below are the Heavy Metals emissions from the Redding Kiln. As best as I can determine, these values are based upon a 1989 source test during which the kiln was fired with 80% coal and 20% tires.

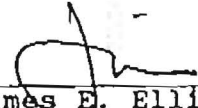
EMITTENT	TESTED EMISSION RATE (lbs/hr)
Arsenic	7.40E-04 (1)
Beryllium	1.10E-04
Cadmium	1.40E-03
Chromium (total)	3.10E-03
Chromium (hexavalent)	6.20E-05
Copper	1.30E-03
Lead	3.90E-03
Manganese	1.00E-02
Mercury	1.11E-02
Nickel	1.70E-02
Selenium	4.30E-03
Zinc	7.80E-01

I hope this is helpful. Please let me know if you need any other information.

$$\begin{aligned}
 & 4) \frac{7.4 \times 10^{-4} \times 0.454 \text{ kg/hr}}{180/24 \times 0.9072 \text{ Mg clinker/hr}} = \\
 & \quad 4.9 \times 10^{-6} \text{ kg/Mg CK}
 \end{aligned}$$

Best regards,

CALAVERAS CEMENT COMPANY

  
 James E. Ellison,  
 Plant Manager

JEE:lb(WP-908)

A CBR Company

# Att. 8

SOURCE  
EMISSION  
EVALUATION


December 15, 1994

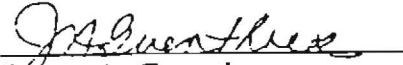
Prepared For:

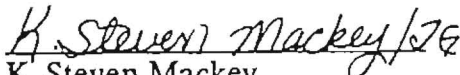
*POX copy*

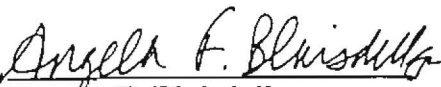
ASH GROVE CEMENT COMPANY  
MAIN CEMENT KILN STACK  
SEATTLE, WASHINGTON  
SEPTEMBER 26-27, 1994

Submitted by:

  
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Am Test-Air Quality, Inc.  
Preston, Washington

*We certify that the information contained herein is accurate and complete  
to the best of our knowledge.*

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## 1.0

### INTRODUCTION

---

The purpose of this source emission evaluation was to quantify emissions from the main cement kiln at Ash Grove Cement Company's facility in Seattle, Washington. Ash Grove Cement Company in Portland, Oregon contracted Am Test-Air Quality, Inc. based in Preston, Washington to perform these emissions tests at the Seattle facility on September 26-27, 1994. This testing was performed to provide data to assist Ash Grove Cement with characterizing the emissions of hazardous air pollutants (HAPs) from the Western Region's kilns and in preparing their Title V operating permit applications. This data will also be useful in long range plans for further testing in the cement industry coordinated by the Portland Cement Association (PCA), which consults with the Environmental Protection Agency (EPA) about these plans.

The kiln stack gas was tested to quantify emissions of polychlorinated dibenzodioxins (PCDD), polychlorinated dibenzofurans (PCDF), hydrogen chloride (HCl), hydrogen fluoride (HF), ammonium ( $\text{NH}_4^+$ ), calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), volatile organic compounds (VOC) measured as total hydrocarbons (THC) and speciated VOCs.

Testing and analysis procedures used for this project are presented in the July 1, 1993 edition of the Environmental Protection Agency (EPA) document Title 40, Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A, Methods 1, 2, 3A, 4, 23, 25A and 26; and in Compendium Method TO-14 from the June 1988 edition of the EPA document 600/4-86/017 titled EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. Methods 1 and 2

were performed to measure the gas velocity and temperature for calculating the volumetric flow rate. Method 3A was performed to determine the molecular weight of the stack gas based on measurements of oxygen ( $O_2$ ), carbon dioxide ( $CO_2$ ) and carbon monoxide (CO). Method 4 was performed to measure the moisture content of the stack gas. Method 23 was performed to quantify emissions of polychlorinated dibenzodioxins (PCDD) and polychlorinated dibenzofurans (PCDF) using a semi-volatile organic sample train (semi-VOST). Method 25A was performed to measure the parts per million (ppm) of volatile organic compounds (VOC) expressed as total hydrocarbons (THC), as propane, using a flame ionization analyzer (FIA). Method 26 was performed to quantify emissions of chloride (as hydrogen chloride (HCl)), fluoride (as hydrogen fluoride (HF)), ammonium ( $NH_4^+$ ), calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K). Samples were collected for speciated VOC analysis using Compendium Method TO-14. This method allows an integrated sample of gas to be collected in an evacuated electropolished SUMMAR<sup>R</sup> stainless steel canister. The samples were analyzed for speciated VOCs using a gas chromatograph equipped with a mass spectrometer detector (GC-MS). In addition, the samples were analyzed using a gas chromatograph equipped with a flame ionization detector (GC-FID) for  $C_1$ - $C_6$  non-substituted alkanes and higher molecular weight VOCs. Two (2) Method 1, 2, 3A, 4, 23, 25A, 26 and TO-14 tests were performed on September 26, 1994 at the kiln stack while the unit was operating with the raw mill on. One (1) Method 1, 2, 3A, 4, 23, 25A, 26 and TO-14 test was performed on September 27, 1994 at the kiln stack while the unit was operating with the raw mill off.

Mr. K. Steven Mackey, Mr. James A. Guenthoer and Mr. E. Ray Lawrence of Am Test-Air Quality, Inc. performed the field sampling. Sample recovery was performed by Ms. Stacy Akin and Ms. Annika M. Woehr of Am Test-Air Quality,



Inc. Data reduction, quality assurance review and final report preparation were performed by Mr. Kris A. Hansen, Ms. Angela F. Blaisdell, Ms. Jan W. Alden, Ms. Cassie B. Heaton and Ms. Woehr of Am Test-Air Quality, Inc. Huntingdon Engineering & Environmental, Inc. of St. Paul, Minnesota analyzed the Method 23 samples for PCDD/PCDF. CH2M HILL Applied Sciences Laboratory of Corvallis, Oregon analyzed the TO-14 SUMMA<sup>R</sup> canister VOC samples. Am Test, Inc. of Redmond, Washington analyzed the Method 26 samples for chloride, ammonia, fluoride, calcium, magnesium and potassium. Mr. Hans Stench of Ash Grove's Portland facility and Mr. Jerry Brown of Ash Grove's Seattle facility coordinated the testing program and provided Am Test with production data recorded on the test days.

## 2.0

### SUMMARY OF RESULTS

---

The following subsections of this report present the results from the testing performed on September 26-27, 1994 at the cement kiln stack. Refer to the Table of Contents to locate specific information for each test method. The summary tables in this section contain information obtained from computer printouts of results for each individual run which are included in Appendix A of this report. Tests of the same type conducted at the same operating condition are averaged together. Table 2.0 (in section 2.0) is a summary table which presents the list of the 189 hazardous air pollutants (HAPs) and the emission rates of each HAP which was quantified during this evaluation in pounds per hour (lb/hr) and potential tons per year (tons/yr). Appendix B of this report contains the laboratory analysis data including a list of some tentatively identified VOCs not shown in the summary of results section. This is discussed further in Section 2.4 of this report. Appendix C of this report contains example calculations of results and copies of the original field data sheets. Appendix D of this report contains production information provided by Ash Grove Cement Company. Appendix E of this report contains miscellaneous supporting information including schematics of the sample trains used. Sampling deviations and/or process difficulties are discussed in Section 3.0 of this report titled "Project Overview/Exceptions".

It should be noted, that tons per year (tons/yr) calculations throughout this report are based on 24 hours per day 365 days per year kiln operation, thereby reflecting the potential to emit (PTE). Results designated with a "U" were undetected at the given quantitation limit (QL) or detection limit (DL). Certain analytes were detected below the reporting limit and are designated with a "J" in the laboratory



data in Appendix B of this report. Results designated with a "J" are estimated values, therefore Am Test reports these results using the "U" designation. In cases where a compound is found in levels above the detection limit for only 1 or 2 of 3 runs, the data should be considered to be less significant than cases where a compound was found for all runs. The data becomes increasingly significant as the concentration value increases in orders of magnitude above the blank value or detection limit (DL). The converse of this would be true as the concentration value approaches the detection limit. A factor of 5 times the DL or blank is typically used by analytical laboratories to determine the significance of a value.

**TABLE 2.0 - SUMMARY OF HAZARDOUS AIR POLLUTANTS QUANTIFIED**

File name: S716\AGSEAHAP  
Client: Ashgrove Cement Company  
Location: Seattle, Washington  
Sample Site: Main Cement Kiln Stack  
Date: September 26-27, 1994

	RAW MILL ON		RAW MILL OFF	
	lb/hr	tons/yr	lb/hr	tons/yr
<u>SW-846 Method 0011</u>				
Acetaldehyde				
Acrolein				
Formaldehyde				
Methyl Ethyl Ketone (2-Butanone)				
Methyl Isobutyl Ketone (Hexone)				
Propionaldehyde				
Quinone				
 40 CFR 60, Methods 13A, 13B, 26/26A <u>SW-846 Methods 0050, 0051, 13A, 13B</u>				
Chlorine				
Hydrogen Chloride	< 0.19	< 0.82	< 0.20	< 0.88
Hydrogen Fluoride	< 0.19	< 0.84	< 0.21	< 0.90
 40 CFR 60, Method 29 <u>SW-846 Method 0012</u>				
Antimony Compounds				
Arsenic Compounds (Inorganic including Arsine)				
Beryllium Compounds				
Cadmium Compounds				
Chromium Compounds				
Cobalt Compounds				
Lead Compounds				
Manganese Compounds				
Mercury Compounds				
Nickel Compounds				
Phosphine (as Phosphorus)				
Phosphorus				
Radionuclides (including Radon)				
Selenium Compounds				
Titanium				

7/2/94

	RAW MILL ON		RAW MILL OFF	
	lb/hr	tons/yr	lb/hr	tons/yr
40 CFR 60, Method 18				
Compendium Method TO-14				
SW-846 Method 0030				(1)
Acetonitrile				
Acrylonitrile				
Allyl Chloride				
Benzene	0.695	3.04	0.835	3.66
Bis (Chloromethyl) Ether				
Bromoform				
1,3-Butadiene				
Carbon Disulfide				
Carbon Tetrachloride	< 0.038	< 0.17	< 0.040	< 0.18
Carbonyl Sulfide				
Chlorobenzene	0.030	0.13	< 0.029	< 0.13
Chloroform	< 0.029	< 0.13	< 0.031	< 0.14
Chloromethyl Methyl Ether				
Chloroprene				
Cumene				
1,3-Dichloropropene				
1,1-Dimethyl Hydrazine				
1,4-Dichlorobenzene (p)	< 0.036	< 0.16	< 0.038	< 0.17
1,4-Dioxane (1,4-Diethyleneoxide)				
1,2-Epoxybutane				
Ethyl Acrylate				
Ethyl Benzene	0.031	0.14	0.035	0.15
Ethyl Chloride (Chloroethane)	< 0.018	< 0.07	< 0.017	< 0.07
Ethylene Dibromide (Dibromoethane)	< 0.046	< 0.20	< 0.049	< 0.21
Ethylene Dichloride (1,2-Dichloroethane)	< 0.024	< 0.11	< 0.026	< 0.11
Ethylene Imine (Aziridine)				
Ethylene Oxide				
Ethylidene Dichloride (1,1-Dichloroethane)	< 0.024	< 0.11	< 0.026	< 0.11
Hexane	< 2.54	< 11.1	< 0.899	< 3.94
Hexachlorobutadiene	< 0.064	< 0.28	< 0.067	< 0.29
Hexachloroethane				
Hydrazine				
Methyl Bromide (Bromomethane)	0.101	0.44	0.129	0.57
Methyl Chloride (Chloromethane)	0.581	2.54	0.497	2.18
Methyl Chloroform (1,1,1-Trichloroethane)	< 0.033	< 0.14	< 0.035	< 0.15
Methyl Hydrazine				
Methyl Iodide (Iodomethane)				
Methyl Isocyanate				
Methyl Methacrylate				
Methyl Tert Butyl Ether				
Methylene Chloride (Dichloromethane)	< 0.021	< 0.09	< 0.022	< 0.10
Nitrobenzene				
2-Nitropropene				
Propylene Dichloride (1,2-Dichloropropane)	< 0.028	< 0.12	< 0.030	< 0.13
Propylene Oxide				
1,2-Propylenimine (2-Methyl Aziridine)				
Styrene	< 0.026	< 0.11	0.040	< 0.18
1,1,2,2-Tetrachloroethane	< 0.041	< 0.18	< 0.044	< 0.19
Tetrachloroethylene (Perchloroethylene)	< 0.041	< 0.18	< 0.043	< 0.19

$$(1) \frac{0.835 \times 0.454 \text{ kg/hr}}{2200/24 \times 0.9072 \text{ Mg CK/hr}} = 4.6 \times 10^{-3} \text{ kg/Mg CK}$$

(Continued)

40 CFR 60, Method 18

Compendium Method TO-14

SW-846 Method 0030

	RAW MILL ON		RAW MILL OFF	
	lb/hr	tons/yr	lb/hr	tons/yr
Toluene	0.282	1.24	0.313	1.37
1,1,2-Trichloroethane	< 0.033	< 0.14	< 0.035	< 0.15
Trichloroethylene	< 0.032	< 0.14	< 0.034	< 0.15
Triethylamine				
2,2,4-Trimethylpentane				
Vinyl Acetate				
Vinyl Bromide				
Vinyl Chloride	0.036	0.16	0.024	0.11
Vinylidene Chloride (1,1-Dichloroethylene)				
Xylenes (Isomers & Mixture)				
o-Xylenes	0.036	0.16	0.039	0.17
m,p-Xylenes	0.042	0.18	0.045	0.20
40 CFR 60, Method 23				
SW-846 Method 0010				
Acetamide				
Acetophenone				
2-Acetylaminofluorene				
Acrylic Acid				
4-Aminobiphenyl				
Aniline				
o-Anisidine				
Benzidine				
Benzyl Chloride				
Biphenyl				
Bis(2-Ethylhexyl) Phthalate (DEHP)				
Caprolactam				
Captan				
Catechol				
Chlordane				
Chloroacetic Acid				
2-Chloroacetophenone				
Chlorobenzilate				
o-Cresol				
m-Cresol				
p-Cresol				
DDE				
Dibenzofurans (Tetra-Octa)	8.1E-05	3.6E-04	0.006	0.025
Dibutylphthalate				
3,3-Dichlorobenzidene				
Dichloroethyl Ether (Bis(2-Chloroethyl Ether)				
Dichlorvos				
N,N-Diethyl Aniline (N,N-Dimethylaniline)				
Diethyl Sulfate				
2,4-Dinitrophenol				
2,4-Dinitrotoluene				
1,2-Diphenylhydrazine				
Epichlorohydrin (1-Chloro-2,3-Epoxypropane)				

(Continued)	RAW MILL ON		RAW MILL OFF	
	lb/hr	tons/yr	lb/hr	tons/yr
40 CFR 60, Method 23				
SW-846 Method 0010				
Ethyl Carbamate (Urethane)				
Heptachlor				
Hexachlorobenzene				
Hexachlorocyclopentadiene				
Hexamethylene-1,6,-Diisocyanate				
Hexamethylphosphoramide				
Hydroquinone				
Isophorone				
Lindane (All Isomers)				
Maleic Anhydride				
Methoxychlor				
4,4-Methylene Bis(2-Chloroaniline)				
4,4'-Methylenedianiline				
Naphthalene				
4-Nitrobiphenyl				
4-Nitrophenol				
N-Nitrosodimethylamine				
N-Nitrosomorpholine				
Parathion				
Pentachloronitrobenzene (Quintobenzene)				
Pentachlorophenol				
Phenol				
p-Phenylenediamine				
Phthalic Anhydride				
Polychlorinated Biphenyls (Aroclors) (Mono-Deca)				
1,3-Propane Sulfone				
Beta-Propiolactone				
Quinoline				
Styrene Oxide				
2,3,7,8-Tetrachlorodibenzo-p-Dioxin				
2,4-Toluene Diamine				
2,4-Toluene Diisocyanate				
o-Toluidine				
Toxaphene (Chlorinated Camphene)				
1,2,4-Trichlorobenzene				
2,4,5-Trichlorophenol				
2,4,6-Trichlorophenol				
Trifluralin				
Polycyclic Organic Matter				
40 CFR 63, Method 308				
Methanol				
40 CFR 60, Modified Method 6				
Cyanide Compounds				



	RAW MILL ON		RAW MILL OFF	
	lb/hr	tons/yr	lb/hr	tons/yr
Compounds with unlisted methods				
Acrylamide				
Benzotrichloride				
Calcium Cyanamide				
Carbaryl				
Chloramben				
Cresylic Acid				
2,4-D, Salts & Esters				
Diazomethane				
1,2-Dibromo-3-Chloropropane				
Diethanolemine				
4,6-Dinitro-O-Cresol & Salts				
Ethylene Glycol				
Ethylene Thiourea				
Glycol Ethers				
Methylene Diphenyl Diisocyanate (MDI)				
N-Nitroso-N-Methylurea				
Phosgene				
Propoxur (Baygon)				

## 2.1 Method 23 - PCDD/PCDF

Three (3) Method 23 samples were collected at the cement kiln stack on September 26-27, 1994 for quantifying emissions of polychlorinated dibenzodioxins (PCDD) and polychlorinated dibenzofurans (PCDF). Each test was performed over a 180-minute sample period to achieve acceptable detection limits. Method 23 uses a semi-volatile organic sample train (semi-VOST) to collect the compounds of interest. The results of these tests are summarized on the following computer printouts titled "Summary of Results - Methods 1, 2, 3A, 4 and 23", "Emission Concentration Results" and "Emission Rate Results". The date, time of each test and process condition are included on the first spreadsheet summarizing the Method 1, 2, 3A, 4 and 23 results. Runs 1 and 2 were performed on September 26, 1994 with the raw mill on. Run 3 was performed on September 27, 1994 with the raw mill off.

The semi-VOST samples were submitted to Huntindon Engineering & Environmental, Inc. for analysis. The combined extract was analyzed using EPA Method 8290 for PCDD/PCDFs using high resolution gas chromatography with high resolution mass spectroscopy (HRGC/HRMS). The laboratory analysis results are presented in units of nanograms (ng) per sample and are included in Appendix B of this report, along with sample and analytical method QA results pertaining to method, field and trip blanks and percent recoveries of internal standards, recovery standards and surrogates. The PCDD/PCDF laboratory analysis results were utilized to calculate the emission concentrations in units of nanograms (ng) per dry standard cubic meter ( $\text{ng}/\text{m}^3$ ). The emission rates were calculated in units of nanograms per minute ( $\text{ng}/\text{min}$ ). The emission concentrations and emission rates for each individual run are presented on computer printouts in Appendix A of this report. The printouts for the individual runs include the field blank and detection

limit values. Am Test does not blank-correct semi-VOST data, so the blank values and the detection limits should be compared to the test data.

All PCDD/PCDF emission concentrations were below  $0.2 \text{ ng/m}^3$  of PCDD equivalents (as 2,3,7,8-TCDD), one of the toxic equivalent benchmark levels that the portland cement manufacturing industry is currently using. The equivalency is calculated by assigning each compound a risk factor (the amount of 2,3,7,8-TCDD that carries that same risk), then the total amount of 2,3,7,8-TCDD which constitutes the equivalent risk of all the individual compounds found in the sample is calculated. The 1989 ITEF list, which was used to calculate the equivalencies, is included in Appendix B of this report.

SUMMARY OF RESULTS - METHODS 1, 2, 3A, 4 AND 23  
AM TEST - AIR QUALITY, INC.

FILE NAME: S705\ASHSVSUM  
CLIENT: Ash Grove Cement Company  
LOCATION: Seattle, Washington

KILN STACK

	RUN #1	RUN #2	RUN #3
AM TEST LAB #:	6665	6666	6667
HUNTINGDON LAB #:	41485	41486	41487
DATE:	9/26/94	9/26/94	9/27/94
START TIME:	11:48	15:53	08:07
STOP TIME:	14:59	19:03	11:17
SAMPLE LENGTH (minutes):	180.0	180.0	180.0
CONDITION (RAW MILL ON/OFF):	ON	ON	OFF
VOLUME SAMPLED (cubic feet):	103.407	104.973	105.470
VOLUME SAMPLED (dry std. cubic feet):	103.228	104.651	103.611
VOLUME SAMPLED (dry std. cubic meters):	2.923	2.964	2.934
STACK GAS MOISTURE (percent):	12.65	12.14	4.38
BAROMETRIC PRESSURE (inches of Hg):	30.05	29.95	30.00
STATIC PRESSURE (inches of H2O):	-0.30	-0.29	-0.69
STACK PRESSURE (inches of Hg):	30.03	29.93	29.95
STACK GAS TEMPERATURE (degrees F.):	231.1	210.7	432.9
STACK GAS TEMPERATURE (degrees R.):	691.1	670.7	892.9
CARBON DIOXIDE (percent):	22.6	22.4	21.6
OXYGEN (percent):	8.7	9.0	9.3
CARBON MONOXIDE (ppm):	642.6	707.2	690.2
MOLECULAR WEIGHT (dry, g/g-mole):	31.96	31.94	31.83
MOLECULAR WEIGHT (wet, g/g-mole):	30.20	30.25	31.22
AVERAGE VELOCITY HEAD (inches of H2O):	0.114	0.111	0.145
PITOT TUBE Cp:	0.84	0.84	0.84
STACK GAS VELOCITY (feet/second):	21.2	20.6	26.7
STACK DIAMETER (inches):	156.0	156.0	156.0
STACK AREA (square feet):	132.7	132.7	132.7
STACK GAS AIRFLOW (dry std. cubic feet per min.):	112895.5	113365.0	120529.8
STACK GAS AIRFLOW (actual cubic feet per min.):	168552.7	163846.6	212963.9
NOZZLE DIAMETER (inches):	0.363	0.363	0.363
ISOKINETICS (percent):	94	95	88

EMISSION CONCENTRATION RESULTS  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS  
AM TEST - AIR QUALITY, INC.

FILE NAME: S715\AGS-CSUM  
CLIENT: Ashgrove Cement Company  
LOCATION: Seattle, Washington  
SAMPLE DATE: September 26-27, 1994

KILN STACK

ANALYTE	Run 1 ng/m3	Run 2 ng/m3	Run 3 ng/m3
2, 3, 7, 8-TCDF	0.005 *	0.044 *	0.279 *
Total TCDF	0.038 B	0.310	11.6
2, 3, 7, 8-TCDD	0.003 U	0.003 U	0.037
Total TCDD	< DL	0.004	4.77
1, 2, 3, 7, 8-PeCDF	0.017 U	0.017 U	0.020
2, 3, 4, 7, 8-PeCDF	0.017 U	0.017 U	0.078
Total PeCDF	< DL	0.034	1.16
1, 2, 3, 7, 8-PeCDD	0.017 U	0.017 U	0.065
Total PeCDD	< DL	< DL	1.60
1, 2, 3, 4, 7, 8-HxCDF	0.017 U	0.017 U	0.017 U
1, 2, 3, 6, 7, 8-HxCDF	0.017 U	0.017 U	0.017 U
2, 3, 4, 6, 7, 8-HxCDF	0.017 U	0.017 U	0.017 U
1, 2, 3, 7, 8, 9-HxCDF	0.017 U	0.017 U	0.017 U
Total HxCDF	< DL	< DL	0.051
1, 2, 3, 4, 7, 8-HxCDD	0.017 U	0.017 U	0.017 U
1, 2, 3, 6, 7, 8-HxCDD	0.017 U	0.017 U	0.023
1, 2, 3, 7, 8, 9-HxCDD	0.017 U	0.017 U	0.019
Total HxCDD	< DL	< DL	0.648
1, 2, 3, 4, 6, 7, 8-HpCDF	0.017 U	0.017 U	0.017 U
1, 2, 3, 4, 7, 8, 9-HpCDF	0.017 U	0.017 U	0.017 U
Total HpCDF	< DL	< DL	< DL
1, 2, 3, 4, 6, 7, 8-HpCDD	0.017 U	0.017 U	0.032
Total HpCDD	< DL	< DL	0.102
OCDF	0.034 U	0.034 U	0.034 U
OCDD	0.055	0.051 B	0.058
PCDD (as 2,3,7,8,TCDD) Equivalent	0.001	0.004	0.143
Total Tetra-Octa PCDD	0.055	0.055	7.18
Total Tetra-Octa PCDF	0.038	0.344	12.8
Total Tetra-Octa PCDD/PCDF	0.092	0.399	20.0

< DL designates that the compound was not detected, or was found at levels below the quantitation limit (DL).

U = not detected at the specified reporting limits.

B = Less than 5 times higher than the background or associated method blank.

ng/m3 = nanograms of analyte collected per dry standard cubic meter of gas sampled.

\* = Value may include contributions from other TCDF isomers.



EMISSION RATE RESULTS  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS  
AM TEST - AIR QUALITY, INC.

FILE NAME: S715\AGS-RSUM  
CLIENT: Ashgrove Cement Company  
LOCATION: Seattle, Washington  
SAMPLE DATE: September 26-27, 1994

KILN STACK

ANALYTE	Run 1 ng/min	Run 2 ng/min	Run 3 ng/min
2, 3, 7, 8-TCDF	17.5 *	140.8 *	954.0 *
Total TCDF	120.3 B	996.5	39556
2, 3, 7, 8-TCDD	10.9 U	10.8 U	128.0
Total TCDD	< DL	13.0	16288
1, 2, 3, 7, 8-PeCDF	54.7 U	54.2 U	68.6
2, 3, 4, 7, 8-PeCDF	54.7 U	54.2 U	267.6
Total PeCDF	< DL	108.3	3956
1, 2, 3, 7, 8-PeCDD	54.7 U	54.2 U	221.0
Total PeCDD	< DL	< DL	5468
1, 2, 3, 4, 7, 8-HxCDF	54.7 U	54.2 U	58.2 U
1, 2, 3, 6, 7, 8-HxCDF	54.7 U	54.2 U	58.2 U
2, 3, 4, 6, 7, 8-HxCDF	54.7 U	54.2 U	58.2 U
1, 2, 3, 7, 8, 9-HxCDF	54.7 U	54.2 U	58.2 U
Total HxCDF	< DL	< DL	174.5
1, 2, 3, 4, 7, 8-HxCDD	54.7 U	54.2 U	58.2 U
1, 2, 3, 6, 7, 8-HxCDD	54.7 U	54.2 U	79.1
1, 2, 3, 7, 8, 9-HxCDD	54.7 U	54.2 U	65.2
Total HxCDD	< DL	< DL	2210
1, 2, 3, 4, 6, 7, 8-HpCDF	54.7 U	54.2 U	58.2 U
1, 2, 3, 4, 7, 8, 9-HpCDF	54.7 U	54.2 U	58.2 U
Total HpCDF	< DL	< DL	< DL
1, 2, 3, 4, 6, 7, 8-HpCDD	54.7 U	54.2 U	109.4
Total HpCDD	< DL	< DL	349.0
OCDF	109.4 U	108.3 U	116.3 U
OCDD	175.0	162.5 B	197.8
PCDD (as 2,3,7,8,TCDD) Equivalent	1.97	14.1	488.6
Total Tetra-Octa PCDD	175.0	175.5	24513
Total Tetra-Octa PCDF	120.3	1105	43686
Total Tetra-Octa PCDD/PCDF	295.3	1280	68200

< DL designates that the compound was not detected, or was found at levels below the quantitation limit (QL).

U = not detected at the specified reporting limits.

B = Less than 5 times higher than the background or associated method blank.

ng/min = nanograms of analyte emitted per minute

\* = Value may include contributions from other TCDF isomers.

## 2.2 Method 25A - Total Hydrocarbons

Three (3) Method 3A, 10 and 25A tests were performed at the cement kiln stack to quantify carbon dioxide ( $\text{CO}_2$ ), oxygen ( $\text{O}_2$ ) and carbon monoxide ( $\text{CO}$ ) for molecular weight calculations and emissions of volatile organic compounds (VOC) measured as total hydrocarbons (THC). Airflow data obtained during concurrent semi-VOST test periods were utilized to calculate gaseous emission rates. The THC emission concentration and emission rate results are summarized on the following computer printout titled "Summary of Results - Method 25A". Runs 1 and 2 were performed on September 26, 1994 with the raw mill on. Run 3 was performed on September 27, 1994 with the raw mill off.

Emission concentrations of  $\text{O}_2$ ,  $\text{CO}_2$  and  $\text{CO}$  were measured continuously on a dry basis in units of percent (%) or parts per million (ppm) using instrumental reference methods. Emission concentrations of total hydrocarbons (THC) were measured continuously on a hot, wet basis in units of ppm using an instrumental reference method. Data from the instruments were recorded once per minute. The data were averaged and the average values were bias-corrected for calibration drift. Moisture data from the concurrent semi-VOST test periods were utilized to convert the wet ppm THC data to a dry basis. The emission rates were reported in pounds per hour (lb/hr) and tons per year (tons/yr).

Copies of the bias-corrected averages for each Method 3A and 25A test are included in Appendix A of this report in printouts titled "Calibration Summary - Gaseous Emission Monitors". Example calculations of the bias correction and THC emission results are included in Appendix C of this report, along with field data and raw 1-minute gaseous data.

SUMMARY OF RESULTS - METHOD 25A  
AM TEST-AIR QUALITY, INC.

FILE NAME: S713\ASHSUMS  
CLIENT: Ash Grove Cement Company  
LOCATION: Seattle, Washington

KILN STACK

	RUN #1	RUN #2	RUN #3	AVERAGE RUNS 1 & 2
	-----	-----	-----	-----
DATE:	9/26/94	9/26/94	9/27/94	
START TIME:	11:55	16:00	08:00	
STOP TIME:	14:55	19:00	11:08	
CONDITION (RAW MILL ON/OFF):	ON	ON	OFF	
AIRFLOW (dry std. cubic feet per min.):	112895.5	113365.0	120529.8	113130.3
AVERAGE STACK GAS MOISTURE (%):	12.65	12.14	4.38	12.40
Bws:	0.1265	0.1214	0.0438	0.1240
METHOD 25A - TOTAL HYDROCARBONS (THC)				
	-----	-----	-----	-----
THC EMISSION CONCENTRATION (ppm, wet):	10.8	10.3	15.4	10.6
THC EMISSION CONCENTRATION (ppm, dry):	12.4	11.7	16.1	12.0
THC EMISSION RATE (lb/hr):	9.58	9.13	13.3	9.35
THC EMISSION RATE (tons/yr):	42.0	40.0	58.4	41.0

### 2.3 Method 26 - Chloride, Fluoride, Ammonium, Calcium, Magnesium, Sodium and Potassium

Three (3) Method 26 tests for quantifying emissions of chloride (as hydrogen chloride (HCl)), fluoride (as hydrogen fluoride (HF)), ammonia (as ammonium ( $\text{NH}_4^+$ )), calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K) were performed at the cement kiln stack on September 26-27, 1994. Runs 1 and 2 were performed on September 26, 1994 with the raw mill on. Run 3 was performed on September 27, 1994 with the raw mill off. The results are summarized on the following computer printouts titled "Summary of Results - Method 26".

The samples were analyzed by Am Test, Inc. for chloride, fluoride and ammonia using ion chromatography (IC) with suppressed conductivity detection. The samples were analyzed by Am Test, Inc. for Ca, Mg, Na and K using Inductively Coupled Plasma (ICP) spectroscopy. The laboratory analysis results are presented in units of micrograms ( $\mu\text{g}$ ) per sample and are included in Appendix B of this report. The laboratory results were converted to emission concentrations of parts per million (ppm) (for HCl, HF and  $\text{NH}_4^+$  only) and milligrams per dry standard cubic meter (mg/dscm). The results were also converted to emission rates of pounds per hour (lb/hr) and tons per year (tons/yr). The printouts include the detection limit (DL) values and the results are reported as a value or as less than (<) the specified DL.

# AMTEST

AIR QUALITY, INC.

## SUMMARY OF RESULTS - METHOD 26 AM TEST - AIR QUALITY, INC.

FILE NAME: S717\ASHM26S  
CLIENT: Ash Grove Cement Company  
LOCATION: Seattle, Washington  
SAMPLE DATE: September 26-27, 1994  
OPERATORS: Guenthoer/Lawrence

### KILN STACK

#### FIELD DATA

CONDITION (raw mill ON/OFF):

AM TEST LAB #:

SAMPLE DATE:

START TIME (24-hour clocktime):

STOP TIME (24-hour clocktime):

INITIAL METER VOLUME (cubic feet):

FINAL METER VOLUME (cubic feet):

VOLUME SAMPLED (cubic feet):

BAROMETRIC PRESSURE (Inches of Hg):

METER TEMPERATURE (degrees F):

METER CALIBRATION FACTOR (Y):

STANDARD VOLUME SAMPLED (dscf):

STANDARD VOLUME SAMPLED (dscm):

AIRFLOW (dscf/min):

	RUN 1	RUN 2	RUN 3	AVERAGE RUNS 1 & 2
CONDITION (raw mill ON/OFF):	ON	ON	OFF	
AM TEST LAB #:	6668	6669	6670	
SAMPLE DATE:	9/26/94	9/26/94	9/27/94	
START TIME (24-hour clocktime):	11:50	16:53	08:19	
STOP TIME (24-hour clocktime):	12:50	17:53	09:19	
INITIAL METER VOLUME (cubic feet):	334.367	339.450	343.841	
FINAL METER VOLUME (cubic feet):	338.536	343.548	347.974	
VOLUME SAMPLED (cubic feet):	4.169	4.098	4.133	
BAROMETRIC PRESSURE (Inches of Hg):	30.05	29.95	30.00	
METER TEMPERATURE (degrees F):	94.3	84.0	93.3	
METER CALIBRATION FACTOR (Y):	1.028	1.028	1.028	
STANDARD VOLUME SAMPLED (dscf):	4.100	4.093	4.065	
STANDARD VOLUME SAMPLED (dscm):	0.116	0.116	0.115	
AIRFLOW (dscf/min):	112896	113365	120530	113130

#### LABORATORY ANALYSIS RESULTS

TOTAL VOLUME OF SAMPLE (milliliters):

CHLORIDE IN SAMPLE (micrograms):

FLUORIDE IN SAMPLE (micrograms):

AMMONIA IN SAMPLE (micrograms):

					DETECTION LIMITS (ug/mL)	DILUTION FACTOR
TOTAL VOLUME OF SAMPLE (milliliters):	100	100	100			
CHLORIDE IN SAMPLE (micrograms):	< 50	< 50	< 50		0.025	20
FLUORIDE IN SAMPLE (micrograms):	< 50	< 50	< 50		0.025	20
AMMONIA IN SAMPLE (micrograms):	56.0	43.0	1900		0.01	10

#### HYDROGEN CHLORIDE (HCl) EMISSION RESULTS

HCl CONCENTRATION IN AIR (mg/dscm):

HCl EMISSION CONCENTRATION (ppm):

HCl EMISSION RATE (lb/hr):

HCl EMISSION RATE (tons/yr):

	DETECTION LIMITS	DETECTION LIMITS	DETECTION LIMITS	
HCl CONCENTRATION IN AIR (mg/dscm):	< 0.44	< 0.44	< 0.45	< 0.44
HCl EMISSION CONCENTRATION (ppm):	< 0.29	< 0.29	< 0.29	< 0.29
HCl EMISSION RATE (lb/hr):	< 0.19	< 0.19	< 0.20	< 0.19
HCl EMISSION RATE (tons/yr):	< 0.82	< 0.83	< 0.88	< 0.82

#### HYDROGEN FLUORIDE (HF) EMISSION RESULTS

HF CONCENTRATION IN AIR (mg/dscm):

HF EMISSION CONCENTRATION (ppm):

HF EMISSION RATE (lb/hr):

HF EMISSION RATE (tons/yr):

HF CONCENTRATION IN AIR (mg/dscm):	< 0.45	< 0.45	< 0.46	< 0.45
HF EMISSION CONCENTRATION (ppm):	< 0.55	< 0.55	< 0.55	< 0.55
HF EMISSION RATE (lb/hr):	< 0.19	< 0.19	< 0.21	< 0.19
HF EMISSION RATE (tons/yr):	< 0.84	< 0.85	< 0.90	< 0.84

#### AMMONIA (AS AMMONIUM (NH4+)) EMISSION RESULTS

NH4 CONCENTRATION IN AIR (mg/dscm):

NH4 EMISSION CONCENTRATION (ppm):

NH4 EMISSION RATE (lb/hr):

NH4 EMISSION RATE (tons/yr):

NH4 CONCENTRATION IN AIR (mg/dscm):	0.51	0.39	17.5	0.45
NH4 EMISSION CONCENTRATION (ppm):	0.68	0.52	23.3	0.60
NH4 EMISSION RATE (lb/hr):	0.22	0.17	7.89	0.19
NH4 EMISSION RATE (tons/yr):	0.95	0.73	34.6	0.84

AGCS2M002634



## SUMMARY OF RESULTS - METHOD 26 AM TEST - AIR QUALITY, INC.

FILE NAME: S717\ASHM26S  
CLIENT: Ash Grove Cement Company  
LOCATION: Seattle, Washington  
SAMPLE DATE: September 26-27, 1994  
OPERATORS: Guenthoer/Lawrence

### KILN STACK

#### FIELD DATA

	RUN 1	RUN 2	RUN 3	AVERAGE RUNS 1 & 2
CONDITION (raw mill ON/OFF):	ON	ON	OFF	
AM TEST LAB #:	6668	6669	6670	
SAMPLE DATE:	9/26/94	9/26/94	9/27/94	
START TIME (24-hour clocktime):	11:50	16:53	08:19	
STOP TIME (24-hour clocktime):	12:50	17:53	09:19	
INITIAL METER VOLUME (cubic feet):	334.367	339.450	343.841	
FINAL METER VOLUME (cubic feet):	338.536	343.548	347.974	
VOLUME SAMPLED (cubic feet):	4.169	4.098	4.133	
BAROMETRIC PRESSURE (inches of Hg):	30.05	29.95	30.00	
METER TEMPERATURE (degrees F):	94.3	84.0	93.3	
METER CALIBRATION FACTOR (Y):	1.028	1.028	1.028	
STANDARD VOLUME SAMPLED (dscf):	4.100	4.093	4.065	
STANDARD VOLUME SAMPLED (dscm):	0.116	0.116	0.115	
AIRFLOW (dscf/min):	112896	113365	120530	113130

#### LABORATORY ANALYSIS RESULTS

				DETECTION LIMITS (ug/mL)	DILUTION FACTOR
TOTAL VOLUME OF SAMPLE (milliliters):	100	100	100		
CALCIUM IN SAMPLE (micrograms):	< 100	< 100	< 100	0.1	10
MAGNESIUM IN SAMPLE (micrograms):	< 100	< 100	< 100	0.1	10
SODIUM IN SAMPLE (micrograms):	< 500	< 500	< 500	0.5	10
POTASSIUM IN SAMPLE (micrograms):	< 1000	< 1000	< 1000	1.0	10

#### METALS EMISSION RESULTS

	DETECTION LIMITS	DETECTION LIMITS	DETECTION LIMITS	DETECTION LIMITS
CALCIUM EMISSION CONCENTRATION (mg/dscm):	< 0.86	< 0.86	< 0.87	< 0.87
CALCIUM EMISSION RATE (lb/hr):	< 0.36	< 0.37	< 0.39	< 0.38
CALCIUM EMISSION RATE (tons/yr):	< 1.60	< 1.60	< 1.72	< 1.66
MAGNESIUM EMISSION CONCENTRATION (mg/dscm):	< 0.86	< 0.86	< 0.87	< 0.87
MAGNESIUM EMISSION RATE (lb/hr):	< 0.36	< 0.37	< 0.39	< 0.38
MAGNESIUM EMISSION RATE (tons/yr):	< 1.60	< 1.60	< 1.72	< 1.66
SODIUM EMISSION CONCENTRATION (mg/dscm):	< 4.31	< 4.31	< 4.34	< 4.33
SODIUM EMISSION RATE (lb/hr):	< 1.82	< 1.83	< 1.96	< 1.90
SODIUM EMISSION RATE (tons/yr):	< 7.98	< 8.02	< 8.59	< 8.31
POTASSIUM EMISSION CONCENTRATION (mg/dscm):	< 8.61	< 8.63	< 8.69	< 8.66
POTASSIUM EMISSION RATE (lb/hr):	< 3.64	< 3.66	< 3.92	< 3.79
POTASSIUM EMISSION RATE (tons/yr):	< 16.0	< 16.0	< 17.2	< 16.6

## 2.4 Method TO-14 - Volatile Organic Compounds

Three (3) EPA Method TO-14 samples were collected at the cement kiln stack on September 26-27, 1994 for quantifying emissions of volatile organic compounds (VOC). The integrated samples were analyzed for speciated VOCs using Method TO-14 by CH2M HILL's Applied Sciences Laboratory. Runs 1 and 2 were performed on September 26, 1994 with the raw mill on. Run 3 was performed on September 27, 1994 with the raw mill off. VOC emission concentration and emission rate results are summarized on the following computer printouts titled "Emission Results - TO-14 Volatile Organic Compounds".

Copies of the VOC laboratory analysis results in emission concentration units of micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) and parts per million by volume (ppmv) are included in Appendix B of this report. VOC emission rates were calculated in units of pounds per hour (lb/hr). VOC emission rate calculations were performed using the laboratory analysis data provided by CH2M HILL and the airflow data collected during concurrent Method 23 testing periods.

Ash Grove requested that a library search of the VOC data be performed by the laboratory to determine whether additional compounds (not included in the Method TO-14 list) may have been present in the SUMMA<sup>R</sup> canister samples. A list of tentatively identified compounds (TIC) is presented in the appendices of this report following the TO-14 laboratory results. Carbon disulfide ( $\text{CS}_2$ ) was not identified in any of the samples.

## EMISSION RESULTS

### TO-14 VOLATILE ORGANIC COMPOUNDS

Am Test-Air Quality, Inc.

File Name: S716\ASHSEASM  
 Client: Ashgrove Cement Company  
 Location: Seattle, Washington

#### MAIN CEMENT KILN STACK

	Emission Concentration				Emission Rate			
	Run 1	Run 2	Run 3	Average	Run 1	Run 2	Run 3	Average
Date:	9/26/94	9/26/94	9/27/94	Runs 1 & 2	9/26/94	9/26/94	9/27/94	Runs 1 & 2
Start Time:	14:20	16:22	09:37		14:20	16:22	09:37	
Stop Time:	15:28	16:58	10:09		15:28	16:58	10:09	
Condition (raw mill on/off):	ON	ON	OFF		ON	ON	OFF	
Analyte	µg/m3	µg/m3	µg/m3	µg/m3	lb/hr	lb/hr	lb/hr	lb/hr
Dichlorodifluoromethane	70 U	70 U	70 U	70 U	0.030 U	0.030 U	0.032 U	0.030 U
Chloromethane	1340	1400	1100	1370	0.567	0.595	0.497	0.581
1,2-Dichloro-1,1,2,2-tetrafluoroethane	100 U	100 U	99 U	100 U	0.042 U	0.042 U	0.045 U	0.042 U
Vinyl chloride	80	88	54	84	0.034	0.037	0.024	0.036
Bromomethane	233	243	287	238	0.099	0.103	0.129	0.101
Chloroethane	38 U	38 U	37 U	38 U	0.016 U	0.016 U	0.017 U	0.016 U
Trichlorofluoromethane	80 U	80 U	79 U	80 U	0.034 U	0.034 U	0.036 U	0.034 U
1,1-Dichloroethene	58 U	56 U	58 U	58 U	0.024 U	0.024 U	0.025 U	0.024 U
Methylene Chloride	49 U	54	49 U	49 U	0.021 U	0.023	0.022 U	0.021 U
1,1,2-Trichloro-1,2,2-trifluoroethane	160	554	3540	357	0.068	0.235	1.60	0.151
1,1-Dichloroethene	58 U	58 U	57 U	58 U	0.024 U	0.024 U	0.026 U	0.024 U
cis-1,2-Dichloroethene	58 U	56 U	58 U	58 U	0.024 U	0.024 U	0.025 U	0.024 U
Chloroform	70 U	70 U	89 U	70 U	0.029 U	0.030 U	0.031 U	0.029 U
1,2-Dichloroethane	58 U	58 U	57 U	58 U	0.024 U	0.024 U	0.026 U	0.024 U
1,1,1-Trichloroethane	78 U	78 U	77 U	78 U	0.033 U	0.033 U	0.035 U	0.033 U
Benzene	1630	1650	1850	1640	0.689	0.701	0.835	0.695
Carbon Tetrachloride	90 U	90 U	89 U	90 U	0.038 U	0.038 U	0.040 U	0.038 U
1,2-Dichloropropane	66 U	66 U	65 U	66 U	0.028 U	0.028 U	0.030 U	0.028 U
Trichloroethylene	76 U	76 U	76 U	76 U	0.032 U	0.032 U	0.034 U	0.032 U
cis-1,3-Dichloropropene	65 U	65 U	64 U	65 U	0.027 U	0.027 U	0.029 U	0.027 U
trans-1,3-Dichloropropene	65 U	65 U	64 U	65 U	0.027 U	0.027 U	0.029 U	0.027 U
1,1,2-Trichloroethane	78 U	78 U	77 U	78 U	0.033 U	0.033 U	0.035 U	0.033 U
Toluene	658	674	694	686	0.278	0.286	0.313	0.282
1,2-Dibromoethane	109 U	109 U	109 U	109 U	0.046 U	0.046 U	0.049 U	0.046 U
Tetrachloroethylene	97 U	97 U	96 U	97 U	0.041 U	0.041 U	0.043 U	0.041 U
Chlorobenzene	70	69	65 U	70	0.030	0.029	0.029 U	0.030
Ethylbenzene	72	76	77	74	0.030	0.032	0.035	0.031
m,p-Xylene	99	102	100	100	0.042	0.043	0.045	0.042
Styrene	61 U	61 U	88	61 U	0.026 U	0.026 U	0.040	0.026 U
1,1,2,2-Tetrachloroethane	98 U	98 U	97 U	98 U	0.041 U	0.042 U	0.044 U	0.041 U
o-Xylene	86	86	86	86	0.036	0.037	0.039	0.036
1,3,5-Trimethylbenzene	70 U	70 U	70 U	70 U	0.030 U	0.030 U	0.031 U	0.030 U
1,2,4-Trimethylbenzene	70 U	70 U	70 U	70 U	0.030 U	0.030 U	0.031 U	0.030 U
1,3-Dichlorobenzene	86 U	86 U	85 U	86 U	0.036 U	0.036 U	0.038 U	0.036 U
1,4-Dichlorobenzene	86 U	86 U	85 U	86 U	0.036 U	0.036 U	0.038 U	0.036 U
1,2-Dichlorobenzene	86 U	86 U	85 U	86 U	0.036 U	0.036 U	0.038 U	0.036 U
1,2,4-Trichlorobenzene	106 U	106 U	105 U	106 U	0.045 U	0.045 U	0.047 U	0.045 U
Hexachlorobutadiene	150 U	150 U	149 U	150 U	0.064 U	0.064 U	0.067 U	0.064 U
Methane	10400	8560	8630	9480	4.40	3.64	3.90	4.02
Ethane	8840	4560	4190	6700	3.74	1.94	1.89	2.84
n-Propene	5110 U	2570	2650	3070 U	2.16 U	1.09	1.20	1.30 U
n-Butane	6740 U	2070	2480	4045 U	2.85 U	0.879	1.12	1.71 U
n-Pentane	8370 U	2870	2860	5025 U	3.54 U	1.22	1.29	2.13 U
n-Hexane	9990 U	2010 U	1990 U	8000 U	4.22 U	0.854 U	0.899 U	2.54 U

T = Exceeded holding time; J = Estimated value; U = Not detected at specified reporting limits

### 3.0

#### PROJECT OVERVIEW/EXCEPTIONS

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An acceptable leak check of less than 0.02 cfm at the highest vacuum rate (or greater) used during the test preceded and followed each Method 23 run. The average percentage isokinetics for each Method 23 run were within the acceptable limits of  $100 \pm 10\%$ , with the exception of run 3, which was 88%. This was due to the moisture in the gas stream being considerably lower when the raw mill is off (4% compared to 12%).



## SOURCE OPERATION

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Ash Grove Cement Company's portland cement plant located in Seattle, Washington was rebuilt in 1992. The plant consists of a kiln and mills capable of producing 750,000 tons of cement per year. The raw materials include limestone, silica sands, and an iron source, which are proportioned according to their chemistry to produce the proper raw mix. The mixed materials are reduced to 1-1/2 inch or less in size and are milled to a powder before entering the kiln systems' preheating tower. The feed passes through several stages in the preheater before it reaches the kiln, where high temperature chemical reactions change the feed into portland cement clinker. The clinker, along with 5% gypsum addition, is ground in the finish mills. The cement is stored in silos for bulk shipments or to be sacked. Gases from the kiln system normally pass through the raw mill for drying before exhausting to the baghouse and main stack.

Am Test performed two (2) Method 1, 2, 3A, 4, 23, 25A, 26 and TO-14 tests on September 26, 1994 at the kiln stack while the unit was operating with the raw mill on. One (1) Method 1, 2, 3A, 4, 23, 25A, 26 and TO-14 test was performed on September 27, 1994 at the kiln stack while the unit was operating with the raw mill off. Production data recorded on the test day provided by Ash Grove personnel are included in the appendices of this report.



## 5.0

### SAMPLING AND ANALYSIS PROCEDURES

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#### 5.1 EPA Methods 1 and 2 - Velocity, Temperature, and Airflow

EPA Method 1 procedures were used to assure that representative measurements of volumetric flow rate were obtained by dividing the cross-section of the stack or duct into a number of equal areas, and then locating a traverse point within each of the equal areas. Refer to the "Stack Schematic and Location of Sample Points" data sheet and/or the figure titled, "Location of Sampling Ports and Traverse Points", located in the appendices of this report, for a schematic of the stack and the point locations selected for testing. Method 2 was performed to measure the stack gas velocity using a type S or a standard pitot tube, and the gas temperature using a calibrated thermocouple probe connected to a digital thermocouple indicator. The type S pitot tubes were connected with tubing to an oil-filled inclined manometer, a hook gauge manometer or magnehelic gauges to obtain velocity measurements. The pitot tube lines were leak-checked and the pressure measurement device was leveled and zeroed prior to use. Calibration information for each pressure and temperature measurement device used are included in the appendices of this report.

#### 5.2 EPA Method 3A and 10 - Molecular Weight

The stack gas composition was determined using EPA Method 3A procedures, which allow the use of instrumental analyzers. A paramagnetic or electrochemical analyzer was used to measure the percent (%) oxygen ( $O_2$ ) and a non-dispersive infrared (NDIR) analyzer was used to measure the % carbon dioxide ( $CO_2$ ). An NDIR analyzer was used to measure the parts per million (ppm) carbon monoxide (CO). The manufacturer and model number for the specific analyzers used are detailed on the "Continuous Analyzer Checklist" in the appendices of this report.

Certified O<sub>2</sub> and CO<sub>2</sub> gases were utilized to check the calibration of the instruments after each test. The O<sub>2</sub> and CO<sub>2</sub> data were used to calculate the molecular weight of the stack gas.

The Method 3A sample system is illustrated in the figure titled "EPA Method 3A, 6C, 7E and 10 Sample Train" in the appendices of this report. Also included in the appendices are specifications for the analyzers used along with copies of the certificates of analysis for the calibration gases used. An effluent gas sample was drawn through a stainless steel sampling probe and out-of-stack filter which were sufficiently heated to prevent condensation. A calibration valve was connected to the inlet of the probe for the purpose of introducing calibration gas to flood the probe. The gas sample passed through a refrigerator type moisture removal system which continuously removed condensate from the sample gas. A Teflon sample line was used to transport the gas sample to the continuous monitoring system. A Teflon coated leak-free pump was utilized to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. A sample flow rate control valve and rotameter were used to maintain a constant sampling rate within 10 percent. Data from the instruments were recorded once per minute using a data acquisition system.

The combustion gas measurement system was assembled on-site and calibration gases were introduced and adjustments were made to calibrate the instrument. The sampling system components were adjusted to achieve appropriate sampling rates. Sampling was continuous, with a calibration check (calibrated upstream of the analyzers) at the end of every test run and a sampling system bias check (calibrated through the probe) at the end of every three (3) runs (maximum).

### 5.3 EPA Method 4 - Moisture

The percent moisture in each gas stream was quantified by weighing the impingers to 0.1 grams before and after each Method 23 run on a digital top-loading balance. The net weight (final minus initial) was used to calculate the amount of moisture condensed from the known volume of stack gas collected.

### 5.4 EPA Method 23 - Semi-Volatile Organic Sample Train (Semi-VOST)

Emissions of polychlorinated dibenzodioxins (PCDD) and polychlorinated dibenzofurans (PCDF) were quantified by collecting and analyzing semi-volatile organic sample train (semi-VOST) samples (formerly referenced as Modified Method 5) specified in Method 23. Samples were collected over three (3) hour sample periods to assure adequate detection limits. The Method 23 sampling train is illustrated in a figure titled "Semi-Volatile Organic Sample Train" in the appendices of this report. Particulate phase organics are collected in the probe rinse and on an ultrapure quartz filter, and vapor phase organics are adsorbed on XAD-2 sorbent which is packed in specially designed modules. The contract laboratory (Huntingdon Engineering and Environmental, Inc.) prepared the sorbent modules. After sampling, each portion of the train was recovered and extracted, then the extracts were combined and concentrated for analysis. The combined extract was analyzed for the presence of PCDDs and PCDFs using high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) by EPA Method 8290. The results were presented in units of total nanograms (ng) per sample. Results were converted to emission concentration units and mass emission rate units.

Prior to arriving at the job site, all sample train components from the first impinger forward were rigorously cleaned to avoid organic contamination. Am Test does not



use silicon grease with the glassware which is utilized in these sample trains, which helps reduce the chances of contamination from previous use. All glassware and sample train components were rinsed with reagent grade acetone, washed with non-ionic detergent and hot water, rinsed thoroughly with hot tap water, rinsed several times with deionized water and baked for 2 hours at  $>500^{\circ}$  F. Prior to use, the glassware was given a final rinse with methylene chloride ( $\text{CH}_2\text{Cl}_2$ ) which has been distilled in glass. All openings where contamination could occur were kept covered with clean ground glass stoppers and plugs, or with heavy duty aluminum foil which had been rinsed with  $\text{CH}_2\text{Cl}_2$ .

The vapor phase semi-volatile compounds of interest were adsorbed on precleaned XAD-2 resin packed in the sorbent modules. The sorbent modules Am Test utilizes are constructed of borosilicate glass with a ball joint on one end and a socket joint on the other end. The resin is held in place with plugs of glass wool which have been solvent extracted and oven-dried. XAD-2 is a porous polymer resin with high surface area which has the capability of adsorbing a broad range of organic species. The sorbent module is expected to give efficient collection of vapor phase organic materials with boiling points greater than approximately  $200^{\circ}$  F. The glass sorbent cartridges and end caps were cleaned and prepared by the analytical laboratory according to procedures specified in the reference methods. One (1) XAD-2 cartridge was kept by the laboratory as a lab blank. One (1) module was placed in a clean sample train in the field, to expose the ends for the time it takes to assemble, leak check and disassemble the sample train. The ends were replaced and the module was labeled as the field blank. One (1) module remained in the container which was used to store the modules and was not opened. The unexposed module was labeled as the trip (or transport) blank. All sorbent modules were kept in a cooler containing blue ice coolant packets, except during sampling.

Prior to sampling, the semi-VOST sample train was assembled and determined to be leak free following the procedures in Method 5. Under no circumstances was silicon stopcock grease used to facilitate passing the leak test. A quartz sample nozzle was attached to a heated quartz probe liner which was used to draw a sample from the gas stream. The probe liner temperature was monitored to assure that condensation did not occur. The probe liner was housed inside a stainless steel probe sheath to prevent breakage. The probe was attached to a glass filter assembly with a Teflon filter support and Teflon gasket, containing a Whatman QM-A ultrapure microfiber quartz filter. The filter was enclosed in a temperature controlled heated sample box. The average sample box temperature surrounding the filter was maintained at a temperature of  $248 \pm 25^{\circ}$  F. Once the gas has passed the quartz fiber filter, it enters an ice water-cooled coil condenser which cools the gas stream to a temperature below  $68^{\circ}$  F before it enters a sorbent module packed with XAD-2 resin. The sorbent module has a water-cooled jacket surrounding the resin to further cool the gas and assure that the semi-volatile compounds of interest remain trapped in the resin. The water-cooled coil condenser and sorbent module were mounted vertically atop the first impinger of the sample train. The first impinger was modified with a short stem and acts as a condensate knockout trap. The condensate percolates through the sorbent resin module for subsequent collection for organic analysis. The temperature at the inlet to the sorbent resin module was monitored with a flexible thermocouple probe which was inserted in a well in the side of the module to assure that the temperature remained below  $68^{\circ}$  F throughout the test period.

At the downstream side of the sorbent module, four (4) impingers were connected in series and immersed in an ice water bath. The first impinger, or condensate knockout, was connected to the outlet of the sorbent module, and collected any



condensate which percolated through the sorbent module. The second impinger was a modified Greenburg-Smith bubbler which contained 100 milliliters of ASTM Type II water for scrubbing acid gas from the gas stream to protect the dry gas meter and pump. The third impinger was empty, and the fourth bubbler contained indicating silica gel desiccant to absorb any moisture from the stack gas before it entered the control box. The back-half section was maintained at a temperature below 68° F by keeping the impingers cooled in an ice water bath. The temperature at the outlet of the silica gel bubbler was monitored.

The sample train was connected to a control box by means of an umbilical cord which contains a vacuum hose, pitot lines, thermocouple wires and a 4-wire electrical cord. The control box (meter box) is used to monitor stack conditions. The control box contains a leak-free pump used to pull the stack gas through the sample train, fine and coarse metering valves to control the sampling rate, a vacuum gauge which measures the pressure drop from the sampling nozzle to the metering valves and a calibrated dry gas meter readable to 0.001 cubic feet. The dry gas meter inlet and outlet temperatures were monitored by thermocouples which are connected to the multichannel thermocouple indicator. The dry gas meter calibration factor, Y, is determined by calibrating the meter against a standard laboratory dry gas meter.

Following sample collection, the semi-VOST sample was transferred to Am Test's mobile laboratory for recovery. The nozzle and probe were disconnected from the sample box and the ends were capped. Any particulate matter collected on the outside of the probe was wiped off before cleaning the probe liner. The filter holder was also disconnected and the ends were capped. The contents of the nozzle, quartz probe liner and prefilter glassware were quantitatively transferred to a labeled glass

sample container with a Teflon lined lid. The glassware components in the sample train were rinsed three times with acetone, then three times with methylene chloride and recovered into one sample container. Then the components were given a final rinse with toluene into the same sample container. The solvents were dispensed from Teflon squeeze bottles. An iodine flask with a female ball joint end was attached to the male ball joint end of the probe to assure that no liquid was lost during the cleaning of the probe. The probe rinses were transferred to the sample containers and the liquid level was noted.

The quartz filter was removed from the filter assembly and transferred to a labeled glass sample container with a Teflon lined lid. In the laboratory, the filters were solvent extracted for subsequent organic analysis. The back-half of the filter holder and the pre-sorbent module connecting glassware, including the coil condenser, were rinsed with acetone,  $\text{CH}_2\text{Cl}_2$ , and toluene into the appropriate sample container which contained the solvents from the probe rinse. The solutions were shipped to the contract laboratory for subsequent extraction and analyses.

Immediately upon completion of a sample run, the labeled sorbent module containing XAD-2 resin was capped with ground glass plugs and stoppers, wrapped in aluminum foil and placed in bubble wrap to protect the modules from breakage, and refrigerated until their contents were extracted and analyzed. The particulate phase, vapor phase, and aqueous phase fractions from each semi-VOST sample were each extracted and their extracts were combined for concentration in a Kuderna-Danish (K-D) apparatus. The concentrates were analyzed by HRGC/HRMS using EPA Method 8290.

## 5.5 EPA Method 25A - Total Hydrocarbons

To quantify emissions of volatile organic compounds (VOC), a portion of the stack gas was continuously extracted and passed through a Method 25A total hydrocarbon (THC) analyzer. The stack gas was drawn from the stack through a heated stainless steel probe, an out-of-stack heated filter, and a heated teflon-lined sample line with the temperature maintained above 150° C. The stack gas was analyzed on a hot, wet basis for total hydrocarbons (THC), using a total hydrocarbon flame ionization analyzer (FIA). The manufacturer and model number for the specific analyzers used are detailed on the "Continuous Analyzer Checklist" in the appendices of this report. The instrument maintains a constant internal temperature of 160° C. Copies of the specifications for this instrument are included in the appendices of this report. The analyzer was calibrated with standard EPA Protocol 1 propane gases and reports propane concentrations on a wet parts per million basis. Moisture data collected during each test period were used to convert the wet ppm data to a dry basis. Measurements from the instrument were digitally recorded once per minute. Sampling was continuous, with a calibration check using zero and span gas after each run.

## 5.6 EPA Method 26 - Chloride, Fluoride, Ammonium and Metals

The sample train used for chloride (as hydrogen chloride (HCl)), fluoride (as hydrogen fluoride (HF)), ammonium ( $\text{NH}_4^+$ ) and metals including calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K) sampling was an EPA Method 26 design as illustrated in the figure titled "Method 26 Sample Train" in the appendices of this report. The "Sample Train Information Sheet" (also in the appendices) details the type of nozzle, probe, probe liner and filter used along with the contents of the sample train impingers. A heated sample probe and heated sample valve were used to pull the sample from the stack. The gas passed through a heated

teflon filter holder with a 47 mm teflon filter inserted between the probe and the impingers. All connections were made with teflon tubing. The impingers contained 0.1 N sulfuric acid ( $\text{H}_2\text{SO}_4$ ) to absorb  $\text{HCl}$ ,  $\text{HF}$ ,  $\text{NH}_4^+$ ,  $\text{Ca}$ ,  $\text{Mg}$ ,  $\text{Na}$  and  $\text{K}$  from the gas stream. A vacuum hose connected the sample train to the control box. The control box contained a diaphragm pump, a fine metering valve, a calibrated dry gas meter (low flow), and ancillary electrical connections.

A point of average velocity was selected from airflow information obtained prior to testing. All Method 26 samples were collected at a point of average velocity. The sample train was leak checked prior to testing according to Method 26 criteria. The probe was inserted into the stack with the probe tip positioned at a point of average velocity. The probe was then purged with stack gas. Upon verification that all operating parameters were representative, sampling began. A flow rate of 2 liters per minute was established using a flow meter. Following sample collection, a post-test leak check was performed.

After sample collection, the contents of the first three (3) impingers containing 0.1 N  $\text{H}_2\text{SO}_4$  and condensed moisture were quantitatively transferred to a 100 mL volumetric flask. The impingers and connecting glassware were rinsed with deionized water and these rinses were added to the impinger solution in the volumetric flask. The flask solution was diluted to exactly 100 mL with deionized water and transferred to a leak free sample bottle. The sulfuric acid solution from each run was analyzed by Am Test, Inc. for chloride, fluoride and ammonia using ion chromatography (IC) per Method 26 and for  $\text{Ca}$ ,  $\text{Mg}$ ,  $\text{Na}$  and  $\text{K}$  using Inductively Coupled Plasma (ICP) spectroscopy.



## 5.7 EPA Method TO-14 - Volatile Organic Compounds

Integrated samples of the gas were collected using Compendium Method TO-14 for volatile organic compound (VOC) analysis. The TO-14 sample train is illustrated in the figure titled "TO-14 Sample System Schematic (with Moisture Removal)" in the appendices of this report. This ambient air testing method was used for this source testing project to collect integrated samples of gas in evacuated SUMMAR<sup>R</sup> electropolished stainless steel canisters. The integrated samples were analyzed using EPA Method TO-14, which utilizes a gas chromatograph equipped with a mass spectrometer (GC-MS) to quantify a standard list of volatile organic compounds. In addition, the samples were analyzed using a gas chromatograph equipped with a flame ionization detector (GC-FID) for C<sub>1</sub>-C<sub>6</sub> non-substituted alkanes and higher molecular weight VOCs.

The TO-14 sampling apparatus included a stainless steel probe, a mechanical critical orifice flow regulator or metering valve, and a 0-30 inch vacuum gauge to monitor canister vacuum. The system is specifically designed to collect uniformly integrated air samples over a predetermined time period. Because of moisture in the stack gas, the sample system was modified to collect the condensate for organic analysis. A stainless steel probe was inserted into the port to pull a gas sample through the flow controller through a moisture removal system and into the canister. The sample valve was attached to an empty, Teflon knockout impinger prior to entering the SUMMA canister. The impinger was kept packed in ice in an insulated cooler. The impinger exit was attached to a stainless steel "T" connection, with the side branch connected to a rotometer which was connected to a metering valve. The metering valve was connected with Teflon tubing to a vacuum gauge atop the SUMMA canister with a sample pump attached. To initiate sampling, the probe valve was closed and the system was pumped to a 15 inch vacuum (" Hg), then the



sample valve was closed and the system was allowed to rest for at least 60 seconds to see if any leakage problems existed. Once the system was verified to be leak-tight, the probe valve and the SUMMA canister valve were opened simultaneously to allow gas to pass through the system until a vacuum of 1" Hg (or less) was achieved. The condensable VOC's were collected in the knockout impinger and the VOC vapors were collected in the SUMMA canister. The integrated air sample was stored in electropolished SUMMA<sup>R</sup> six-liter stainless steel canisters for transport and subsequent analysis. The interior surfaces of these stainless steel canisters were passivated using the Moleetrics SUMMA<sup>R</sup> process.

To recover the sample, the liquid was poured into a VOA vial and was capped. The VOA vials were then placed inside another container which had a small amount of charcoal in it to absorb ambient hydrocarbons. The VOA vials and the SUMMA canisters were packaged and shipped to the laboratory for analysis. The condensate analysis results in micrograms per liter ( $\mu\text{g/L}$ ) are converted to emission concentration units using the liquid volume (in milliliters) and the capacity of the SUMMA canister (6 liters).

CH2M HILL Applied Sciences Laboratory, the outside contract laboratory used to analyze these samples, owns and maintains the integrity of the SUMMA<sup>R</sup> passivated canisters and performs leak tests to assure that they can contain a gas sample over time. To prepare the canisters, the contract laboratory heated them in an isothermal oven to 100° C. Once heated, the canisters were evacuated and maintained under vacuum for several hours. At the end of the heated/evacuation cycle, the canisters were pressurized with humid zero air and were quality assurance checked with a gas chromatograph equipped with a flame ionization detector. Once

certified clean, the canisters were reevacuated and remained in the evacuated state until they were used.

Each canister was labeled with an identification tag before it was returned to the contract laboratory for analysis. Upon return receipt of the canisters by the contract laboratory, the pressure of each canister was checked by attaching a pressure gauge to the canister inlet and opening the valve briefly to note the pressure. The sample canister was connected to the inlet of the GC-MS-SCAN analytical system. A mass flow controller was placed on the canister and the canister valve was opened. Following preliminary flushing, the canister flow was vented past a tee inlet to the analytical system. The sample was preconcentrated in a cryogenic trap, then the trapped analytes were thermally desorbed onto the head of the column to be separated and scanned. Primary identification is based on retention time and relative abundance of eluting ions as compared to the spectral library stored on the hard disk of the GC-MS data system. The concentration of each compound was calculated using the previously established response factors. Analysis of the gas contained in the canisters was accomplished using GC-MS as described in Method TO-14. Analysis of the VOCs contained in the condensate was performed by Quality Analytical Laboratories, Inc. (QAL) of Redding, California using GC-MS as described in SW-846 Method 8260.

## 6.0

### QUALITY ASSURANCE PLAN

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The purpose of the quality assurance plan is to provide guidelines for achieving quality control in air pollution measurements. The detailed procedures which are utilized are included in the Environmental Protection Agency's (EPA's) reference manual titled Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, EPA-600/4-77-027b. These procedures are followed throughout equipment preparation, field sampling, sample recovery, analysis and data reduction. Am Test-Air Quality, Inc.'s quality assurance procedures are discussed below.

#### 6.1 Calibration Procedures and Frequency

Field equipment utilized for on-site measurements is calibrated at a frequency recommended by the equipment manufacturer or industry practice. Prior to field use, each instrument is calibrated and the calibration value is recorded. If any measuring or test device requiring calibration cannot immediately be removed from service, the Project Manager may extend the calibration cycle providing a review of the equipment's history warrants the issuance of an extension. No equipment will be extended more than twice a calibration cycle, nor will the extension exceed one-half the prescribed calibration cycle. Test equipment consistently found to be out of calibration will be repaired or replaced.

The sample nozzles used to collect isokinetic samples are calibrated on-site before sampling using digital inside calipers readable to 0.001 inch. Three (3) measurements were taken at varying points around the inside of the nozzle tip and averaged. The dry gas meters used to accurately measure sample volumes are

calibrated using a standard laboratory dry gas meter. The type S pitot tubes utilized for velocity determination are calibrated using Method 2, Section 4.1, and are inspected regularly for wear. The magnehelic gauges used for pressure measurements are checked against an oil-filled manometer. The digital thermocouple indicators used for temperature measurement have a readability of 1 degree Fahrenheit and are periodically re-certified by the manufacturer. Each thermocouple probe used to monitor temperature is checked periodically at three (3) temperature settings. Copies of calibration information for each measurement device used are included in the appendices of this report. A barometer readable to 0.01 inches of mercury is used in the field to obtain barometric pressure readings. Barometers are checked routinely against a mercury barometer in Am test's laboratory.

The gaseous measurement systems are capable of meeting the system performance specifications detailed in 40 CFR 60, Appendix A, Method 6C, Section 4. For meeting these specifications, the analyzer's calibration error must be less than  $\pm 2$  percent of the span for the zero, mid-range, and high-range calibration gases. The sampling system bias must be less than  $\pm 5\%$  of the span for the zero, and mid- or high-range calibration gases. The zero drift must be less than  $\pm 3\%$  of the span over the period of each run. The calibration drift must be less than  $\pm 3\%$  of the span over the period of each run. Copies of the certificates of analysis for each tank of calibration gas used are included in the appendices of this report. The calibration gases were analyzed following the EPA Traceability Protocol Number 1, or next best available. Purified nitrogen was utilized for the zero gas.

Support equipment is defined as all equipment, not previously discussed, that is required for completing an environmental monitoring or measurement task. This

equipment may include storage and transportation containers, sample recovery glassware, and communications gear. Support equipment is periodically inspected to maintain the performance standards necessary for proper and efficient execution of all tasks and responsibilities.

During a project, a systems audit is performed, consisting of an on-site qualitative inspection and review of the total measurement system. This inspection is conducted on a daily basis by the Project Leader. During the systems audit, the auditor observes the procedures and techniques of the field team in the following general areas:

- Setting up and leak testing the sample train
- Isokinetic sampling check (if applicable)
- Final leak check of the sample train
- Sample recovery

Visual inspections of pitot tubes, glassware, and other equipment are also made. The main purpose of a systems audit is to ensure that the measurement system will generate valid data, if operated properly.

## 6.2 Sample Recovery and Field Documentation

Data collected during each test, are immediately inspected for completeness and placed under the custody of the Project Leader until custody is transferred when the samples were returned to the Air Quality laboratory. Sample recovery is carried out in a suitable area free from particulate matter contamination. Each sample is assigned an identifying lab number to assist the chemists in tracking the sample.

## 6.3 Chain of Custody

The history of each sample was documented from collection through all transfers of custody until it was transferred to the analytical laboratory. Copies of the chain of



custody forms are included in the appendices of this report. Internal laboratory records document the custody of the samples through their final disposition. Care was taken to record precisely the sample type, sample time, and sample location and to help ensure that the sample number on the label exactly matches those numbers on the sample logsheet and the chain-of-custody record. The persons undertaking the actual sampling in the field were responsible for the care and custody of the samples collected until they were properly transferred or dispatched. Sample labels were completed for each sample bottle using water-proof ink.

#### 6.4 Transfer of Custody and Shipment

All sample shipping containers were accompanied by an analysis request or chain-of-custody record form when they left the site. When transferring the possession of samples, the individuals relinquishing and receiving the samples signed, dated, and noted the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory.

The laboratory representative who accepted the incoming sample shipment signed and dated the chain-of-custody record, completing the sample transfer process. It is the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis in accordance with the laboratory's written QA Plan.

It is important to maintain the integrity of the samples from the time of collection until the analyses are performed. The samples were preserved during transportation and storage to prevent or retard degradation or modification of chemicals in samples. The Method 23 and Method 26 samples were kept cool with blue ice packets placed in the coolers the sample were shipped in. Prior to shipping

the samples, the samples were placed in boxes or coolers along with a chain-of-custody form. Empty space in the box or cooler was filled with bubble pack and styrofoam to prevent damage during shipment. The samples were shipped via UPS for next day delivery.

## 6.5 Data Reduction, Validation and Reporting

Raw data are handled according to strict guidelines when being transposed into computer files or to other logs. The guidelines include document receipt control procedures, file review, and sign-off by a project assistant. Raw data are entered into the appropriate computer spreadsheet by a "processor", then the entered figures are checked for accuracy by a "checker", different from the "processor". Any mistakes are corrected, and figures are rechecked and signed off by the "checker". In addition, a by-hand calculation check of each spreadsheet is made using a hand-held calculator to validate the computer output. All data generated by each phase of a laboratory or field sampling program are reviewed by the senior reviewer. The data package is signed off by the senior reviewer prior to releasing the data for report preparation.

The test results were calculated according to EPA 40 CFR 60 criteria. Copies of the pertinent equations used to derive these results are included in the appendices of this report. Standard conditions are 68° F and 29.92 inches-of mercury. Tons per year (tons/yr) calculations are based on 24 hours per day and 365 days per year kiln operation. The average values from instrumental analyzer readings were computed and bias corrected for each test period. The average gas effluent concentration was determined from the average gas concentration displayed by the gas analyzer, adjusted for the zero and upscale sampling system bias checks. Calculations are on a dry basis using the following equation:

$$C_{gas} = (C - C_0) * (C_{ma} / (C_m - C_0))$$

where:

$C_{gas}$  = Effluent gas concentration, dry basis

$C$  = Average gas concentration indicated by analyzer, dry basis

$C_0$  = Average of initial and final system calibration bias check responses for the zero gas

$C_{ma}$  = Actual concentration of the upscale calibration gas

$C_m$  = Average of initial and final system calibration bias check responses for the upscale calibration gas

## 7.0

### METHODOLOGY REFERENCES

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- EPA. Title 40 Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A, Reference Methods 1, 2, 3A, 4, 10, 23, 25A and 26. July 1, 1993.
- EPA. EPA 450/2-79-006, APTI Course, "Course 450 - Source Sampling For Particulate Pollutants", December 1979.
- EPA. EPA 468/2-81-009, APTI Course, "Course 468 - Source Sampling For Gaseous Pollutants", September 1981.
- EPA. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, EPA-60/4-77-027b.
- EPA. EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Method TO-14.